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THE AMERICAN GAS LIGHT JOURNAL

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BRIEFLY TOLD.

THE STATE OF TRADE.—The progress which we are witnessing in the growth of manufacturing in general in America, starting from the low point of trade here in 1896, evidently quickens instead of slowing; and in the rush it is gratifying to know that our division of the trading keeps even pace with the swiftest of them all; and iron is the pace-maker. Our output figures for the first half of 1899, which figures so far represent an annual make of 10 thousand million cubic feet, in which calculation no less than 52 distinct companies are considered, show a gain over the corresponding half of 1898 that amounts to 18.53 per cent. The maximum gain (and it is recorded by a new England company, the annual output by which may be put at less than 75,000,000 cubic feet) shown in percentage is 43.20, and the minimum gain (reported by a New York State company) is 9.38. From our returns it would seem that the greatest improvement in gas sales has been manifested in the Middle, Eastern and Middle Western States, and in the order named is the gain shown. In this calculation but one company with an output exceeding 300,000,000 is considered; and the output of that company shows an increase that figures at 11.06 per cent. The reports respecting the increased placing of gas stoves are little short of amazing, and, odd enough to say, the figures for the increase on this account, so far as percentage goes, are all in favor of the extreme West. Of course it is an extremely difficult task to sift from the returns, so far as each individual case goes, as to the why and wherefore of the gains reported, but the main assumption from the statistics is that the increments are, on the whole, to be attributed to an enlarged use of gas by those who have used it heretofore rather than to the beginning of such use by or through districts not formerly piped. We do not mean to say that the latter feature is not prominent, in that some reporting companies return main extensions amounting to as high as 10 per cent. plus their former mileage, but on the average the extensions show some less than an increase of 150 miles by the 52 companies that favored us with figures. In connection with piping it is worthy of note that 7 companies say they would have made notable main extensions were it not for the ruling prices quoted for cast, for anything like reasonable time delivery. On the whole, the gas men have small cause for complaint just now; in fact, to the contrary, they should all have the comfort that goes with the knowledge that their product is in excellent demand at fairly remunerative prices.

PROGRESS OF STREET LIGHTING BY MEANS OF WELSBACH LAMPS.—The streets of our large cities furnish abundant evidence that the Welsbach lamp for purposes of public outdoor illumination steadily gains favor; and right here in New York city may be shown the best proof that our statement is correct. The Welsbachs now at work in the boroughs of Manhattan and Brooklyn give unqualified satisfaction to those who are obliged to travel the roadways after nightfall, and their upkeep cost, so far as the renewal of mantles is concerned, is surprisingly small. The only thing needed to make the system perfect is a means of lighting and extinguishing the lamps automatically, and that need is not so far from being met as many imagine. In fact it is hoped that, by the time the American Gas Light Association meets here in next annual

session, a fair way of automatically working the lamps, even though it may be done by or in limited districts, will be shown.

NOTES.—Mr. Samuel Trumbore, who had charge some years ago of the Easton (Pa.) Company's works, has again resumed active business in connection with the industry. At any rate, he informs us that he has accepted the post of Engineer and Superintendent to the Company which will construct the new works at Bangor, Pa.——Mr. John W. Mish, whose connection with the Lebanon (Pa.) Gas Company covers a period of two score and five years, evidently does not intend to retire just yet, for current events show that he has had completed this summer, under his direct supervision, many betterments on the Lebanon plant. The betterments included the renewing of two benches of 6's, on the Flemming generator plan, which work of course was actually done by Messrs. J. H. Gautier & Co., of Jersey City, N. J., and the erecting of a new set of purifiers.——The proprietors of the Gallipolis (O.) Gas and Coke Company are congratulating themselves and complimenting Superintendent J. H. Maxon over the fact that the increase in output for the first half of 1899, as compared with the output for the first half of 1898, is not much under 40 per cent. The Company is increasing its generating capacity by adding a new bench of 4's, and further equipment is an exhauster and a tar extractor.——Under the agreement between the authorities of Manitowoc, Wis., and Messrs. John Nagle, Julius Lindstedt, Emil Tietgen, Henry Vits and Michael Dempsey, the latter agree to construct, and have in operation within two years, a gas works. The franchise is to run for 35 years, and it is stipulated that the rates to be charged on illuminating and fuel account shall not exceed $1.25 and $1 per 1,000 cubic feet, respectively.——A mortgage for $115,000, executed by the Peekskill (N. Y.) Gas Light Company to the Farmers' Loan and Trust Company of this city, has been recorded.——Mr. William H. Swindell, General Superintendent of Lamps and Public Lighting, of Baltimore, Md., has prepared in pamphlet form, the city ordinances governing gas meters and the consumption of gas. The matter was compiled for the benefit of the taxpayers at large, many of whom complain daily of the condition of their meters. The laws state that it is the duty of the Gas Company to place correct meters upon the premises of all consumers of gas, and see to it that the meters are kept in proper working order and condition; further, that it shall not be lawful for the Company to charge, under any circumstances, for a greater amount of gas than is registered by the meter. Before being put in service the meters must first have been inspected, proven correct and sealed by the General Superintendent of Lamps and Lighting, at a cost to the Gas Company of 25 cents per meter. After the meters are in place, and are not working satisfactorily to the consumer of gas, they may be taken out and inspected by the Superintendent at a cost of $1 to the consumer. This fee is to pay for the actual work of testing the meter, hauling it to and from the City Hall Annex, etc. The fee is not returned to the consumer if the meter is found to be measuring accurately."

Automatic Gas Lighters.

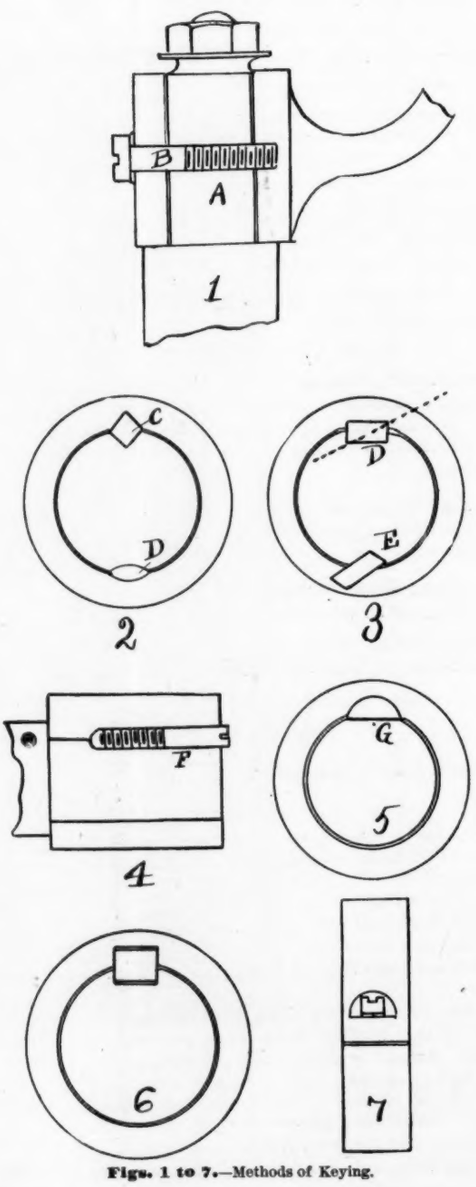
The *Journal of Gas Lighting* says that at the last meeting of the *Société Technique du Gaz en France*, the subject of lighters was dealt with in communications by M. Castoul, M. Dulac and M. Jouanne. The first named gentleman described a lighter applicable to street lamps fitted with ordinary flat flame or Welsbach burners. In the latter case, the lighter is furnished with a Bunsen burner rendered anti-vibratory by the interposition of a very flexible spring between the two cones. The system of lighting described by M. Dulac consists of a three-way tap, a lighting tube and an improved lighter. The tap is so arranged that, when the lever is horizontal, the gas is entirely shut off; when it stands at 45°, the gas passes to the tube; and when it is vertical, the gas goes only to the burner. The lighting tube is so arranged that, when the lamplighter manipulates the lever of the three-way cock, his lamp passes in front of the lower part of the tube when the lever is at about 45°. The lighting of the tube is consequently effected without the lamplighter abandoning the lever. By continuing the movement, the burner is lighted and the tube extinguished. M. Jouanne described the Besnard system for automatically lighting and extinguishing gas burners at a distance. The appliance is operated by the variations in pressure at the time of lighting and extinction; and it requires in conjunction with it a small flash light. The author pointed out that, in order to insure the satisfactory working of the system, it would be necessary to have an even pressure; and therefore an irregular district might present insurmountable difficulties to its introduction. Where, however, the levels do not vary, and for public lamps, large establishments, railway stations, theaters, assembly rooms and similar places, he thought self-lighting appliances, based upon pressure, might be used with success. In the case of railway stations, he pointed out that the system could be made to lower the lights to mere jets when the platforms were not in use, and bring them up to their full power on the arrival of a train.

[Prepared for the JOURNAL.]

Gas Pipe Engineering.

By MECHANICAL ENGINEER.

Keys for fastening work to shafts may be classed under three heads. One class includes the ordinary types of flat keys, which act as diagonal struts, and are usually employed for the heavier forms of work in which security is a factor. The second class includes the square keys, which hold by shearing strain, and which are suitable for general use. The third class of keys, or fastening screws and related devices, includes special forms of keys, combination connection, etc. In Fig. 1 is shown a form of fastening device of the special order. The bearing is cylindrical, and the post is secured from turning in it by means of the screw *B*, which passes through as shown. This method of connection is defective in several points, and after several months' use becomes loose.



Figs. 1 to 7.—Methods of Keying.

Cases have come to the notice of the writer in which the key has been cut off completely by the strain.

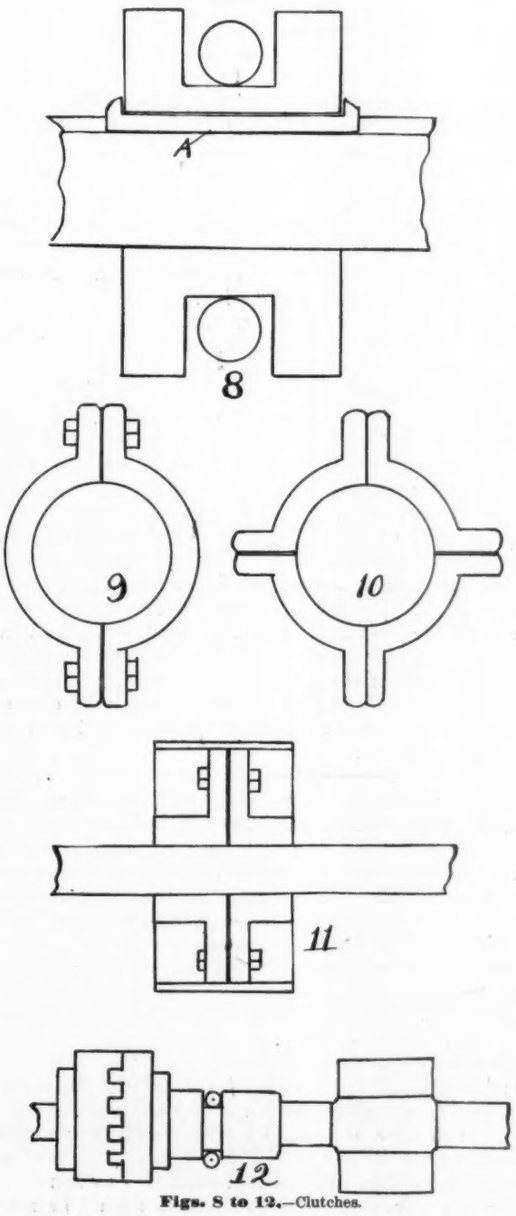
How to Rectify.—One way to rectify a fastening of this type consists in cutting one or more key seats for putting in keys.

Methods of Keying.—Some repair men use the diamond-shaped form of key, shown at *C* in Fig. 2. This key is not a serviceable one for gear connection. The tendency is for the beveled edges of the key seat to bear unevenly upon the edges of the key, resulting in unequal strain and frequently causing the key to weaken or loosen from its position.

Oval Form of Key Defective.—At *D* is shown the unreliable design

of oval key which some vehicle machinists use, owing to the ease with which the seats for such a key may be filed out in the work and shaft with a common round file; but these keys lack retaining power. Every motion of the work tends to strain the key, which is devoid of the sides presented by square and flat keys, and, therefore, has no positive means for getting the proper grip. Even full round keys are better, especially if true holes are bored and the pins are properly threaded.

Flat Keys.—In Fig. 3, at *D*, is shown the usual pattern of flat key, which is extensively used. These keys drive as struts from diagonal corners as represented by the dotted line. The essential point is to get an accurate fit with these keys. If there is a spring in them at any



Figs. 8 to 12.—Clutches.

point, due to uneven keys or key seats, the connection will give considerable trouble and will probably work loose. In some cases the key is inserted in the form shown at *E*, but as a rule these flat keys are put in like the specimen at *D*.

Threaded Keys.—If the conditions are such that the work can be drilled out perfectly true and tapped for a threaded pin, the round form of key or pin can be used with good results, such as is shown at *F*, Fig. 4. Keys of this type can be provided with means for turning out, therefore making it easy to remove the connection and replace it at any time. The key shown in Fig. 5, at *G*, has been found in use on some machines by the writer. This style of key is to be condemned, as it usually fails to remain tight. No key seat is made in the shaft for it, there being simply a flattened place, made on the shaft with a file. The part of the key that contacts with this flat place is also flat, and is supposed to bear hard enough to assure a secure fit. But a bad fit usually results and the work soon loosens.

Feather Keys Reliable.—The common feather or square key is about the best and safest key to use. This form of key is shown in Fig. 6. If the key fails to hold, then there is something wrong with the fit. Some men make the mistake of shaping the key to bear at the top and bottom of the key seat, in which case the key will work out in a very short time. Always have the key bear firmly on the sides regardless of the top and bottom.

Split Collar.—In Fig. 7 is shown a convenient form of split collar for employment for retaining parts on shafts next to keyed work. These collars should be kept in stock in different sizes. They can be turned out from brass, iron or other metal, and a shoulder sunk into each side just over the split to receive the screws. The collars are not intended to receive a heavy thrust, but, if properly fitted to the shaft, the pressure of the screws will bind the collar sufficiently tight to resist considerable pressure.

Sliding Keys.—Sliding feathers are used largely in motor vehicle work in conjunction with shifting clutches. One of these is shown in Fig. 8, in which the key is indicated, *A*. A key-way of good proportions is cut into the shaft and is long enough to allow the key to move or slide in it the required distance to permit the clutch to operate. The key is fitted permanently in the clutch and moves with it. In making this description of key, precaution is required to get all parts uniform to prevent binding. If necessary, two feathers instead of one may be used.

Clamp Couplings.—Clamp couplings are very useful in repair and construction shop, as use for the couplings occurs frequently. The clamp couplings are serviceable to join broken shafts and to steady sprung spindles, etc. The simplest form of clamp coupling is shown in Fig. 9, consisting of two sides, while in Fig. 10 there are four sides. Greater security is obtained in the latter, as more bolts for clamping the sections closer and firmer to the shaft are available. The clamp is bored out a little larger than the shaft in each case, which gives some room in which to tighten up. The principal point to observe in making these clamp couplings is to get the bore correct. The holes for bolts are drilled into a template, and this is reversed for each section of the clamp and the boring is done on a drilling machine.

Flanged Couplings.—A flanged coupling is of course very different in its construction from a clamp coupling, one of the former of which is shown in section in Fig. 11. These flanges are in use on such shafts as require disconnection for various purposes. In making them they should be turned all over, except the web plates, and finished on the circumference. The muff form of flange shown in Fig. 12 consists in keying the flange with one or more keys to the shaft in such manner that it may be driven off at will.

Test of Frozen Concrete.

Engineering Record says it is a commonly accepted opinion among engineers that the construction of concrete masonry, particularly above ground, during freezing weather, is bad practice and to be avoided if possible. This would limit concrete work in the vicinity of Chicago to the months of April to October inclusive, a comparatively short time. It has frequently been necessary for the Bridge and Building Department of the Chicago, Milwaukee & St. Paul Railway to put in Portland cement concrete foundations during the winter. There has, however, been a feeling of uncertainty as to the effect of freezing before the concrete thoroughly set, and Mr. Walter A. Rogers, assistant engineer in this department, accordingly made a series of tests to obtain reliable data on this most important subject. These he recently described in a paper before the Western Society of Engineers, and from the "Journal" of this Society the following abstract of his paper has been prepared.

The tests were made with Atlas Portland and Louisville cements made into concrete blocks measuring 12 inches on a side. The Portland cement concrete was mixed in the proportion of one part of cement, three parts of gravel, and four parts of broken stone; the Louisville cement concrete was composed of one part of cement, two parts of gravel, and four parts of broken stone. The gravel was composed of about two parts of clean coarse sand and one part small stones. The broken stone was crushed limestone. The cubes were all made by the same man, and those for the same kind of cement were made on the same or succeeding days. The specimens were molded in

boxes, in which they were left until taken out to be broken. Two of the eight cubes of each kind of cement were mixed with salt water made in the proportion of a pint of salt to ten quarts of water. The other six were mixed with ordinary hydrant water. Two of the latter were kept in a warm office until broken, and were used for purposes of comparison. Four were placed out of doors as soon as mixed, in a temperature considerably below zero, and left outside for 28 days. Two of them were then broken and two taken into the warm office and left for 28 days longer before breaking. The two cubes of each test which were mixed with salt water were placed outside as soon as made, and left to thaw and freeze until broken at the age of 28 days. During this period the outside temperature was the coldest experienced in Chicago for more than 20 years, although during the latter part of the time the temperature rose and the cubes were exposed to freezing at night and thawing during the day.

The two cubes made with Portland cement and left in the office developed an average strength of over 185,000 pounds, which was the capacity of the testing machine. Their strength probably did not much exceed this figure, as one of them began to fail under the pressure The two cubes which were placed outside in a temperature of about 15° below zero immediately after being made, developed an average strength of 115,000 pounds after 28 days. The two cubes made at the same time and left out of doors for the same period and then kept in a warm room for 28 days more, developed a strength of over 185,000 pounds. They were probably stronger than the two cubes left in the office for 28 days, because no sign of failure in either of them was manifest. The two cubes mixed with salt water and then exposed to the cold for 28 days developed a strength of over 185,000 pounds, probably about the same amount as that of the two unexposed cubes.

The deductions which Mr. Rogers makes from these Portland cement tests are: Freezing before setting does not seem to injure the Portland cement concrete, even if, after having frozen hard, the concrete is exposed to alternate freezing and thawing weather. Exposing green Portland cement concrete to a freezing temperature seems to affect its rate of hardening, making it slower, but eventually the concrete will be just as good as if it had not been exposed to the cold. The use of salt seems to largely counteract the effect of cold in causing slow hardening.

In the case of the cubes made with Louisville cement, the strength of the specimen kept in the warm office for 28 days and then broken was 43,400 pounds. The second cube kept under these conditions proved defective. The two cubes placed outside as soon as made and then left to freeze and thaw for 28 days showed an average strength of 33,000 pounds. The two cubes made at the same time and left in the cold for the same period and then kept in a warm office for 28 days more had an average breaking strength of 52,500 pounds. The two cubes mixed with salt water and exposed for 28 days developed a strength of 35,000 pounds, but little more than was the case of the cubes made with fresh water and similarly treated.

The same deductions may be made, according to Mr. Rogers, from the tests of Louisville cement concrete as from the Portland test, except that the use of salt seemed to have little if any effect on the strength of the cubes exposed to the cold. "The fact that the extreme cold seems to have merely caused the hardening of the concrete to proceed more slowly than under more favorable conditions of temperature is brought out in a marked manner by the fact that the strength of the cubes left out in the cold for 28 days and then kept inside for 28 days developed a strength 20 per cent. greater than was the case with those kept inside for 28 days and then broken."

Mr. Rogers closes his paper with a statement concerning a retaining wall built during the latter half of November, 1898. This was constructed of Louisville cement concrete with Portland cement mortar facing on the top and front. The weather was quite cold for part of the time during which the concrete was mixed, and some of it must have frozen before setting had been completed. The 2-inch plank form was left in place until spring and about 4 or 5 inches of sand was placed on top of the wall. On removing the form it was found that the body of the concrete was in good condition to all appearances. About 6 inches from the top, however, the Portland cement facing was badly cracked, and, by sounding, occasional spots were both found in the facing and in the back of the wall where there was apparently a thin, loose shell. Evidently these were surface defects and the wall itself seemed to be in good condition.

During the discussion an anchor block of concrete, 14 feet square and 65 feet long, built for a 100 ton shear-leg crane, was described. This had to be built during freezing weather, the temperature being below zero for a portion of the time. About half the mass was below the surface of the water, but as the sole purpose of the anchor was to furnish weight, no particular care was taken to make the concrete extra strong. It was made of one part of Milwaukee cement, two parts of sand and four to five parts broken stone. The materials and water were heated and mixed with reasonable care, and about a double handful of salt was added to each pail of water. Ice formed over the top of the concrete every night, sometimes to a thickness of 6 inches, until the work was above the surface of the river. When a mass was above water level, no attempt was made to protect it from frost. About six months later it was reported that the concrete was failing, but an inspection showed this was untrue, and when an attempt was made to cut into it some time later the material was found to be hard and thoroughly set.

On the Continuous Mode of Testing Gas.

[A lecture delivered by Prof. C. R. C. Tichborne, of Dublin, Ireland, at the last Meeting of the North of Ireland Association of Gas Managers.]

In 1892 I had the pleasure of addressing this Association "On the Value of the Bye Products of Gas Works, and on Improved Methods of Estimating Them." I then dealt chiefly with the Metropolitan Gas Referees' methods for the estimation of ammonia and the total sulphur. I propose now to give you what, if you like, you may consider to be a continuation of that subject; but I should say at once that it only touches upon the estimation of ammonia.

In the previous paper I pointed out that a great change had occurred in the position since the days when the Referees first made their regulations. At that period it was only a question of providing against a very high percentage of ingredients which were then viewed as impurities. But now the manufacturer of gas finds these substances of such commercial value that he displays the greatest anxiety to separate them as far as possible from the gas. If he is not getting his proper proportion of ammonia and sulphur, it is so much money lost. In most cases he has to sell the bye-products on the unit of sulphur or ammonia which they contain; and therefore the estimation of these substances has become a question of the highest importance to him.

Now the following is the *modus operandi* of the Referees' process for ammonia. A volumetric or standard solution of sulphuric acid is taken; and a measured amount of this solution is placed in a glass cylinder filled with glass beads, and provided with a tap at one end. At this point comes in a possible source of error. Some scientific instrument makers send out an apparatus filled with common beads made of soft glass, that so act upon the sulphuric acid as to render experiments quite useless.

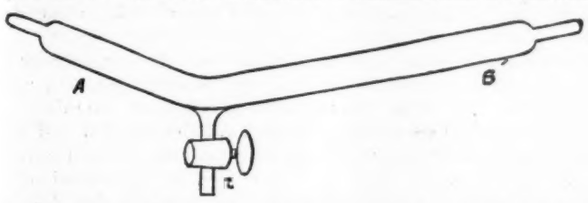
But to resume. This cylinder is not easy to manipulate. You have to insert the exact quantity of volumetric acid into it, and, after closing the tap, turn the cylinder round and round until the whole surface of the beads is well covered. Not only does this require careful manipulation, but at the end of the operation it is difficult to wash out the cylinder so as to be quite certain that you have removed all the contents. If the washing be imperfectly done—say, from haste or careless manipulation—the determination is hopelessly wrong.

After charging the cylinder with the acid, the gas is slowly passed through it—say, at the rate of 2 cubic feet per hour—until the 10 cubic feet have passed. The ammonia in the gas is, of course, at once arrested or neutralized by the sulphuric acid. The contents of the cylinder and washings therefrom are then estimated by a volumetric solution of ammonia; and the difference between the volume of ammonia solution which would be originally required by the acid used, and the volume absolutely used after passing the gas, represents the ammonia which has been absorbed from the 10 cubic feet of gas. This may be said to be a concise description of the process—sufficient to remind us of the points requisite to compare with the process I am now about to describe in detail.

This process involves no manipulatory trouble, is not performed by isolated experiments, and requires no volumetric estimation. If a few simple precautions are taken, the process is absolutely correct. It is essentially a process of saturating a standard solution of acid, but only thus far does it resemble the Referees' process. I pass the gas through two absorption tubes of a peculiar shape. Let us call one *A* and the other *B*.

These tubes are very simple, are specially suited for gas washing, and do not produce any back pressure. Each tube has two limbs, so placed as to have a slight angle to each other—say, an angle of 150°. At each end are narrow inlet and outlet tubes respectively, which can be connected by indiarubber tubing the size of a quill to the gas supply,

etc., as required. The short limb is the inlet, and the long one the outlet. The two tubes are placed on a stand, and the outlet of *A* connected with the inlet of *B*. At the angle of the two limbs is a stop-cock, by which the tubes can be emptied. As thus arranged, they are ready to work. Ten cubic centimeters of standard acid are introduced



into each tube; and the gas supply is connected with the inlet of *A*, and the experimental meter with the outlet of *B*. The gas is then allowed to pass slowly. The standard acid acts as a trap at the bend of the tube. In fact, the gas keeps forcing the liquid up the tube; and as the liquid keeps falling back, a constant movement of liquid and gas is maintained.

It will now be necessary to describe the volumetric solution. I prefer to make it so that each 5 c.c. = 0.00064 gramme, or 0.01 grain of ammonia (NH_3). It is prepared in the ordinary manner—which I need not trouble you with now—or it can be prepared at any of the establishments which make chemical tests. But before making up the final measure, half a grain of methyl orange to each liter should be added. This solution should be made up to its final volume at 60° F. Such a solution is bright red. Methyl orange is supposed to be the most appropriate indicator for ammonia.

Now, as the gas slowly passes through the tubes, you get a point when the tube *A* becomes yellow, instead of red. You know that the gas passed has contained sufficient ammonia to represent 0.02 grain, the equivalent of your 10 c.c. of acid, and you note the volume of gas registered. The saturated standard solution is now removed by the tap from *A*, and a fresh 10 c.c. introduced. At the same time we now connect *B* with the gas, and let *A* become the outlet to the meter. The object of this is that any traces of the ammonia which might possibly have escaped *A* are now locked up in *B*. So the experiments go on continuously; it being only necessary to have a notebook, ruled in three columns—one for the date, one for the measure of the gas, and the third for the ammonia. Thus—

Date.	Gas in Cubic Feet.	Ammonia in Grains.
August 1	9.8	0.02
"	8.7	0.02
"	6.8	0.02
" 2	8.0	0.02
"	7.7	0.02
"	7.9	0.02
" 3	7.1	0.02
"	8 0	0.02
"	8.1	0.02
" 4	7.7	0.02
"	8 2	0.02
	78.2	0.02

Therefore $\frac{200}{78.2}$ = grains of ammonia per 100 cubic feet of gas.

Thus, neglecting the first experiment, 78.2 cubic feet of gas contain 0.2 grain of ammonia, or 0.25 grain in 100 cubic feet. The first experiment is neglected because it contains a slight error—namely, the small amount of gas carried into the tube *B*. Therefore it would be better not to consider it as an individual reading.

In mentioning the volumetric solution, I stated that it should be made up at a temperature of exactly 60° F., because, as I have mentioned before, dissociation of ammoniacal solution by heat is so marked that very exact results can be obtained only by working at uniform temperatures. The following is the difference I have found on an estimation of ammonia at different temperatures, and using methyl orange as the indicator—

50° F	0.1000 grain of NH_3.
55 "	0.1000 "
60 "	0.1000 "
65 "	0.1010 "
70 "	0.1020 "
75 "	0.1024 "
80 "	0.1032 "
90 "	0.1040 "

It will be observed that there is no practical change at low temperatures, but that change is apparent above 60°. Congo red is a good indicator to show these reactions. The methyl orange is the best indicator for use. Phenolphthalene and litmus are inadmissible, because the ammonia comes over largely as carbonate; and these indicators are not reliable under such circumstances. Sir William Crookes' calorimeter, for determinating shades of color, might be used with advantage in fixing the point of neutrality.

In conclusion, I may mention that the principle enunciated here is applicable to many estimations—such, let us say, as to the carbonic acid. I have used divisions which I consider more scientific; but, of course, it is merely a question of transposing, if "septems" are preferred.

Differential Prices for Gas.

[A paper prepared by R. B. ANDERSON, for the last Meeting of the North of Ireland Gas Managers' Association.]

I am induced to bring this subject before you because I consider that under certain circumstances the system of having differential prices is attended with satisfactory results to both shareholders and consumers, and also because the case against the system was so forcibly expressed recently at the Gas Institute meeting by Mr. Newbigging—whose opinions many of us are perhaps too apt to adopt without questioning their application in consequence of the authority with which he is entitled to speak. In all cases, however, we should bring reason to bear upon the merits of our own particular circumstances.

In addressing my present audience I am assuming that most of us are connected with towns in which the price of gas is necessarily high, few having anything to do with gas under 5s.—most of us knowing a good deal about prices running up to 6s. and 7s., and some, at the other end of the scale, having difficulty in making both ends meet with prices bordering on even 8s. Of 80 towns in Ireland of which I have statistics I find 61 charging 5s. and over, 46 charging 5s. 6d. and over, 31 charging 6s. and over, and 14 charging 7s. and over.

In his paper[1] to the Gas Institute, Mr. Newbigging dealt chiefly with comparatively speaking, low priced gas. To-day I am referring chiefly to high-priced gas. It is to those having to charge the highest prices that the adoption of differential rates becomes of most advantage. Where the ordinary price is low the advisability of having differential rates becomes less, until a price is reached which admits of an abatement being made profitably.

In considering the question managers generally associate it with extending the so called "day consumption," but I consider this, to a certain extent, a fallacy. If a line could be drawn between consumption during hours of light draught and hours of heavy draught, as was for a time tried in Brussels, there would be some reason in it; but it is a mistake to call engine and cooking gas "day consumption," unless used while mains and holders would otherwise be idle. During mid-winter lighting, engines, fires and cookers, are in full swing together during the working hours of darkness, necessitating larger mains and holders than would have sufficed if gas were supplied for lighting only. Of course, in so far as such gas is used during hours of daylight an advantage does accrue from it on that account by keeping make and consumption more evenly balanced; but in computing its cost we are not entitled to ignore capital charges for mains and holders altogether. I prefer to associate the question with additional consumption, as I consider that is how the difference chargeable comes in and differential rates are profitable, chiefly because they enable one to sell more gas which otherwise would not be sold at all.

Let us now consider the cost of gas. I do not intend to burden you with many figures, but to succinctly summarise them. I would ask you not to criticise the figures themselves, but merely my application of them. I have analyzed the cost of gas in a certain town thus:

Pro rata charges per thousand	15d.
Reducible " " "	26d.
Profit to pay capital	39d.
Selling price	80d., or 6s. 8d.

In the *pro rata* charges per thousand I include coal, less products, plus purifying material and bad debts, because, quite irrespective of the quantity of gas made, the value of these per thousand remains nearly constant. In the reducible charges I include everything else except profit, because, as you increase the make, the cost per thousand for rents, rates, taxes, repairs, salaries, etc., tends to diminish.

Now, what is the cost of additional gas? The *pro rata* charges re-

1. See JOURNAL, *ante*, p. 203.

main approximately as before, say 15d. The reducible charges can be cut down to 16d., the figure which prevails in works of magnitude. Profit can be cut down to 1s., as any additional capital embarked will more nearly approach the cost per thousand at which large works can be erected. For purposes of argument I put it at about 16s. per thousand, at 6 per cent.

Thus it will be seen that this particular company can sell additional gas profitably at 3s. 7d. per thousand, while its ordinary rate is 6s. 8d. —a very large margin.

If full advantage of approximating light and heavy draught could be taken there would be a still further saving on the charge for profit and also in the reducible charges. I do not see a practicable way of giving the consumers a share of this saving during winter, but I shall show, later, how it can be done during the summer.

Much has been written about the unfairness of differential rates. In business abstract justice has to give way to expediency, and we should not refuse benefits to the many because consequential hardships, generally more imaginary than real, result to the few. Where is there a business all the methods of which are above the reproach of being judged unfair? No matter what lines you conduct your business upon, charges of unfairness can be sustained against you with considerable plausibility by those inclined to do so. We have recently had an excellent lesson in this in the contradictory arguments advanced against the Southern Railway amalgamation. Truly it is, that one man's meat is another man's poison. Self-preservation leads to self-interest, and until the millennium I fear it would not pay for gas companies only to be altruistic in their dealings. I was much impressed by an article on the basis of railway charges which appeared in a recent volume of the "Economic Journal." Railways charge the rate which the traffic will bear. We can deal on similar lines. Gas for lighting will bear a certain price against all competitors; but gas for heating, engines and cookers has to face quite a different competition, and will not bear nearly so high a rate.

Provided you put all your consumers on the same footing I do not see that anyone should have much real cause to complain. Gas companies charging differential rates are not the only traders to whom awkward questions can be addressed. Is it fair that paterfamilias and the lonely widow, who use vastly different quantities, should pay the same water rate because they live in similar houses? Is it fair that a railway should carry folk casually going for pleasure at a cheaper rate than their constant passengers travelling for toil? Is it fair to your old consumers, who have made your business for you, that, when you reduce the price, you should allow their competitors to come on as new consumers at a price less than you, for years, have been charging your old friends? I have had consumers seriously argue that they, as old customers, are entitled to some advantage over new ones. Such questions can be multiplied *ad libitum*, but they only tend to show the impossibility of offering terms that will be considered fair by every party affected.

To those of you who may be contemplating a general reduction I would suggest the following for your consideration. On your books you, no doubt, have many consumers who find it worth their while to burn your gas at the present price, and who would not be tempted to burn more by any reduction in price. If you reduce the price you simply make these consumers a present, and look to recoup what you give to them from new consumers and from old ones who increase their accounts. Now, by differential rates you do not make the consumers who respond to your overtures by consuming more freely recoup you for the loss on those who do not—but all the benefit of the reduction goes to those who increase their turnover with you.

General reductions are, of necessity, small, and those of you selling gas at 6s. or over will find it a long time before you bring down that price to one low enough to tempt consumers to use engines, cookers, etc. But if you make a large reduction for these purposes you can get them on at once, and run no risk of loss of rental. I am no believer in trifling differences of 2½ per cent. and 5 per cent. I do not think there are many of you who could not afford to sell additional gas at 3s. 4d., and I should say "Do so—no matter how much higher your other price may be." At one town we are charging two prices, 6s. 8d. and 3s. 4d. Some of you may be afraid to show such differences. At first you may be inundated with complaints that if you can sell at 3s. 4d. you ought not to charge 6s. 8d., but you can answer them with reason on your side. In one town, some years ago, we were selling at 6s. and 3s. 4d., and a campaign was started against our iniquities in the local twopenny paper, which, fortunately, had a very sensible and fair-minded editor. I entered the lists, drew the fight from gas to papers, and showed that although it was necessary to charge 2d. for the local paper to make it pay, yet how profitable it would be if the editor could get some of his subscribers to take a second copy at 1d., the extra cost to him merely being paper, ink, and a little time, all present reporters, typesetters, etc., sufficing. He had sometimes been twitted for charging 2d. for his little paper, no larger than a Dublin halfpenny paper. I fought his case and our own at the same time, to our mutual satisfaction and the confusion of our enemies.

The usual method of differentiation is to charge one price for lighting gas and a lower price for gas used for other purposes, separate meters being fixed to register the two consumptions. To this there are the objections that an additional meter has to be installed and kept in order, read, booked and accounted; that separate fittings have to be run through the house; that lights are sometimes connected on to the wrong system of fittings—accidentally or otherwise; that fraudulent consumers, by means of an indiarubber tube, can easily connect the two systems of piping; and that in many cases the cost of extra meter, piping, etc., more than counterbalances the difference in price of gas, and in others the nuisance of running a pipe through a house, with the concomitant taking up of carpets, prevents the introduction of a gas fire, which might have been installed if it could have been connected on to the nearest pipe of adequate size.

My first experience with differential rates was on this separate meter system, and its defects quickly came home to me. In conversation with friends working on the same lines, I found it was not at all an uncommon practice for them to get over the difficulty of the extra piping and meter by assuming that, in certain cases, when a consumer put up a stove, all the increase in his account was attributable to the stove, and agreeing that the consumer should pay accordingly. It at once struck me that here was a way out of all my difficulties. It did not matter how a man burned his gas so long as he burned more; and, accordingly, we introduced what, for the sake of an explanatory name, I will call the "Cheap Additional Gas Scheme." We claim no novelty for this method; in fact, after we had been using it for some years we found it had been tried, and abandoned, by a gas company near London some years before we re-started it.

I will now describe how we introduced this system. In office records one had at hand the material for tabulating every existing consumer's account and for estimating normal consumptions for new consumers. Accordingly, we tabulated a consumption for each consumer, and sent him a circular, of which the following is a copy, having an appropriate example suited to each individual worked out on it:

GAS WORKS.....

Rental No.....

.....189....

To Mr.....

With a view to inducing you to burn gas for other purposes than lighting, it has been decided to charge you at the reduced rate of..... .....per 1,000 cubic feet for all the gas you use in excess of the quantities tabulated below, which have been estimated as average normal consumptions for lighting the premises you occupy.

Period ended.....	.....	000	cubic feet.
" "	.....	000	"
" "	.....	000	"
" "	.....	000	"
" "	.....	000	"

For example, suppose your consumption for the current period be .....000 cubic feet, then your account would be—

.....000 c. ft. @	£	:	:
.....000 c. ft. additional @	£	:	:
	£	:	:
As against .....000 c. ft. @.....	£	:	:

The following is a copy of a form of account adapted for working the system:

Gas Works,.....189....

Mr.....

Present index of meter:				
Index of meter at commencement of period				
To gas consumed during period ended on above date.....	00	cubic feet, at	6/8 net.....	£
Tabulated consumption..	00	"	6/8 net.....	£
Additional " ..	00	"	4/2 net.....	£
Meter for same period.....				£
Amount due.....				£

Of late years it has, with reason, been proposed to make a charge for "readiness to supply;" but so far as I am aware no gas company has ventured to do so. What we are doing is, indirectly, very much of this nature; we charge for the first few thousands higher than we do for the remainder, having, so to speak, recouped ourselves for our readiness to supply. The system is somewhat akin to what is known as the Brighton system of charging for electricity, under which the first few hours of consumption are charged at a higher rate than subsequent hours. You will see that this system renders separate meters and meter rents unnecessary; no second set of pipes need be run through the house, a geyser in the bathroom, a shaving water heater in the bedroom, a boiling burner in the nursery, a cooker in the kitchen, a fire in the drawing room, each or all can be connected to the nearest pipe of adequate size, or, if the existing pipes be too small, larger ones can often be run up in place of them with much less trouble than putting in separate ones would entail. If consumers like to put up extra lights we do not mind; and the consumer has no temptation to defraud by using a rubber tube connection amongst his fittings. The introduction of this scheme has entirely taken the wind out of the sails of that class of consumer who was so fond of telling us that if we would make a small reduction they would burn a lot more gas. Now we merely say to them to burn more and the reduction comes to them automatically.

We draw no distinction between our consumers—the smallest and largest have some of their gas at the ordinary rate, and it is entirely in their own hands whether they have any at the low rate or not.

I may say we find some consumers slow to appreciate the system, and some grumble at us still; but the following will show how void of foundation their complaints are, and how carelessly made. We have had several cases where consumers have wound up their complaint by saying, "Why don't you simply have one reasonable price?" We have asked them to name what they consider a fair price, and they have named prices which worked out at more than they were actually paying. Only the other day one said he would prefer we charged him 5s. 6d. rather than our differential rates of 6s. 8d. and 4s. 2d. On its being shown to him that his account averaged out at 4s. 10d., he retired with a very satisfied "Humph, I had not troubled to calculate that myself!"

Having a large consumption at a low rate will eventually react upon the ordinary rate, and enable it to be lowered; but I must confess my sympathies are chiefly with the users of the cheap gas, and I should prefer to reduce the additional gas price to nearly the minimum profitable rate before touching the ordinary price. In 1893 a company near London, on our recommendation, adopted the system, and Mr. Livesey denounced it very emphatically in a paper he read before the Institution of Gas Engineers, prophesying that it would raise an angry feeling amongst the consumers. This, so far as I know, has not been the case. We find with our own consumers that it has rather tended to pacify them, and I instance the following in support of what I say. We introduced the system in one town some six or seven years ago, and last year got a new Act of Parliament without opposition, proving our relations with our consumers to be by no means bad; and, as far as I am aware, not a single individual took advantage of the opportunity to write or speak against the system either in the Press or at the council meetings.

So far, I have not suggested selling gas at anything less than a directly profitable price. There are exceptional cases, however, when selling directly at a loss might be justified by expediency, in consequence of the benefits indirectly accruing. Cheap motive power may be the means of starting industries in a town. Gas companies cannot assist new industries by subscribing for shares or lending money. A grocer in a town may wittingly sacrifice a few hundred pounds to get a mill or a factory started, knowing that a factory means wages being spent in his shop. Gas companies cannot take shares to help on such a company, but they can assist, nevertheless, by supplying at a direct loss—or even free, if they feel the loss will indirectly be made good to them.

If you lower the ordinary price by a small reduction it takes a long time to rehabilitate your profit and loss account. A small reduction may induce a few new consumers and some extra consumption by existing ones, but it does not offer a great inducement to a man to change his methods. If you make a large reduction, though it makes him consider the introduction of engines, cookers, advertising devices, etc., his feeling is "the extra cost is not much, I'll have it." In one town charging 6s. 8d. we were undecided whether to reduce the 6s. 8d. or introduce differential rates. We made a special scrutiny of the town, and came to the conclusion that we had on our books nearly every good shop in the place, excepting a few who burned oil because they dealt in it. We inquired closely as to any others who did not burn gas, and found they fell into three classes—some who objected to gas at any price, others who would not pay deposits and could not safely be given credit, and others whose accounts would hardly be worth having. We came across hardly anyone who would have been tempted to come on as consumers at even a 5s. price. In this town, a few years before, a reduction to 6s. 3d. had been made temporarily, with results not altogether satisfactory to the exchequer. In consequence of a rise in the price of coal the price was put back to 6s. 8d., and when coal fell again a 5s. rate was introduced for additional gas, with such satisfactory results that a further reduction to 4s. 2d. was made three years later. The result has been that the private consumption, which was not increasing at 6s. 8d., and was hardly influenced by a reduction to 6s. 3d., has practically doubled itself in the last six years, since the "cheap additional gas scheme" was introduced. Up to 1886 this company had charged 7s., and the consumption actually decreased for two years after the price was reduced to 6s. 8d. and 6s. 3d. Thus the company had reason to pause ere it made another reduction in the ordinary price.

In another town gas was sold at 6s. 9d., and the consumption was falling. The price was reduced to 5s. 10d., which was rather a heroic step to take. The consumption continued to fall for another year; it then slowly increased for four years, but was still under what it was when 6s. 9d. was charged. We then, in 1892, introduced a 4s. 7d. rate for additional gas, further reduced to 4s. 2d. in 1896; and the result has been that the private consumption has increased by over 53 per cent. in the past six years.

I have referred to the advantage of balancing the light and heavy draughts by augmenting the consumption during hours of daylight and thus getting the benefit of using our plant up to its capacity for a longer time. In one town we are experimenting in this direction. Our prices are 6s. 8d. for ordinary gas, 5s. for additional gas during winter, and 3s. 4d. for additional gas during summer. I do not anticipate that the hourly summer draught will ever exceed what our mains, designed for heaviest winter consumption, are adequate for, or that we shall ever feel, during the summer, that our holders are too small. We must have holders and mains to supply our winter work, a large proportion of the capacity of which is useless during the summer. The whole capital charge need not be debited against gas which will merely harmlessly flow through them, hence a reduced charge in summer is considered justifiable. In this small town we have just fixed a couple of dozen cookers, in consequence. We started the experiment in 1898 and had practically no complaints when the price was raised again after the summer, which was rather a surprise to us.

No one wishes more than I do to sell cheap gas, and it is because of this desire that I am so ardently in favor of differential prices.

[Official Report—Revised by the Secretary—Concluded from Page 335.]

SEVENTH ANNUAL MEETING, PACIFIC COAST GAS ASSOCIATION.

Held in San Francisco, Cal., July 18 and 19, 1899.

Second Day, Afternoon Session.

The Wrinkle budget having been disposed of the President introduced Mr. Leon P. Lowe, who prefaced his paper[1] on

ARTIFICIAL ILLUMINATION FOR ORDINARY BUSINESS AND DOMESTIC PURPOSES,

with the following remarks:

Mr. Lowe—Let me preface the paper by saying that it was not prepared as a paper to be read before the Association. It is rather a compilation of data with which you are all familiar, and subsequently some tables were prepared to put it in a graphic form. This paper which was written about a year ago, was gotten together to convince customers that the Welsbach incandescent gas light is the best and cheapest light to be had to-day, commercially considered. At the time it was written, the Equitable Gas Company, in San Francisco, Cal., manufacturing gas under the Hall process, had not started. It is true its proprietors are selling gas at less than $1 per 1,000, but their gas, however, is nothing more than a mixture of producer oil and coal gas, and a small quantity of water gas. It *is* a fuel gas, but a very poor one, notwithstanding what may be claimed for it, and I do not think it can be considered in competition with any good commercial gas to-day.

1. For Mr. Lowe's paper, see Journal, Aug. 7, p. 209.

The diagram shows graphically the amount of light given for $1 by different kinds of lights at different prices. Gas is considered at from $2.50 per 1,000 to $1. Electricity is considered at 20, 15 and 10 cents per 1,000 watts. The Welsbach light is considered on the same basis as the ordinary open flame, and acetylene gas is considered at both 6 and 7 cents per pound for calcic carbide, with the assumption that a pound will produce 5 cubic feet of gas. You will see that the most expensive light is the electric incandescent at 20 cents, and the cheapest is the Welsbach with gas at $1 per 1,000. At the request of Mr. E. C. Jones I prepared a paper showing at what prices electricity must be sold by meter to equal in point of economy the Welsbach gas light. It may be news to some of you to know that at any of these rates for electricity the electric lighting companies could not live for a single day, while gas with the Welsbach burner will go merrily on.

Discussion.

Mr. Jones—I did not intend to take part in the discussion, but I must say I am glad to see such a paper presented at this time. I think Mr. Lowe covered the ground thoroughly. There is no doubt that the gas business to-day is in its infancy, and that the real, true-blue gas man, the man who has gas for his text and will stay with it, has a field that will last him, his sons and his sons' sons, with a good profit.

Mr. Eichbaum—We are under obligations to Mr. Lowe for his paper and his tables. Perhaps to some of us who have an opportunity of reading the gas light journals, it is not altogether new. It is not everybody, however, who can read them. Some take them and have not time; but this puts the matter in such shape that I think every gas man can go from here well satisfied that there is no possibility whatever of electric light driving out gas, which is very comforting knowledge.

Mr. Lowe—I think it is the duty of every gas man to get a sample of everything that comes on the market in the shape of improvements in gas appliances. I have recently seen an incandescent mantle that could be taken from the lamp, passed from one hand to the other, rolled about, and when put back on the lamp burn just as well as one that had not been handled. Although a great move in the right direction, the Welsbach lamps are to-day very poor things. Giving a great deal of trouble, people use them only where the greatest amount of economy is necessary and when the greatest amount of light is used, as in the dining room and living room. In bed rooms, halls and the remainder of the house the ordinary burner is still generally in use. Aside from the matter of expense, the Welsbach is still very trouble some, although the Company exploiting it is doing everything to make it a first-class article. We can help every man who is endeavoring to better the condition of affairs by keeping in touch with him. If you see anything advertised that costs only a few cents, send and get it. Lots of them are worth absolutely nothing, but at any rate you are encouraging the man who is striving to help us. That is my practice, and I think it a good thing to do.

Mr. Gutsch—It seems to me, in order to make mantles more durable, they would have to be made of something more substantial than the materials now nsed. I would be glad to know what the composition of the mantle is which Mr. Lowe mentioned.

Mr. Lowe—I do not know what the mantle was made of, nor do I keep in touch with the processes of manufacture of mantles; but I know a good mantle when I see it. This particular make of mantle was a surprise to me and did excellent work. If our good friend sitting near the door, Mr. Ewing, does not close up all the other mantle manufactories in the country, we may hope for still greater advances in that line of business. I would like to say a word more concerning my paper. Of course, all these rates are based on electricity as used through an ordinary electric meter. In many cases electricity is sold by a flat rate and thus the electric lighting companies seem to get ahead. The fact of the matter is, however, that before any business can be a thoroughly established commercial success, each individual member of the public must pay for what he gets and only that, and not assist in paying the bills of somebody else. Where electricity is sold at a flat rate a great deal of it is delivered at a price that does not pay the cost of generating it. Somebody else must pay for that. If the gas man will only make the consumer understand this he will have no difficulty at all in forcing the electric light people to put on meters. Just as soon as a consumer is taught that he is paying dividends to the electric lighting company and also helping to pay the bill of somebody else, he will see to it that he has an electric meter; and the minute meters come generally into use (as they eventually must, just as water meters must), just so soon must the electric light companies increase their selling rates. Water power cannot live as against the Welsbach. The incandescent light is the best light in the world, but the gas consuming public use the cheapest light; they must use the Welsbach burner on good commercial gas.

Mr. Powers—I do not think anything could be added to this. The figures are self-evident and speak for themselves. It is a very interesting paper and I think we all appreciate it.

SOME FRATERNAL COMMUNICATIONS.

The Secretary—I have received a telegram from Mr. George Treadway Thompson, last President of the Western Gas Association. He is in Denver, Col., and wires:

"Best wishes for a successful meeting. I am prevented from visiting you this year, but count upon joining you a year hence."

A great many of the members, especially older ones, have noticed the absence of Past-President Parker from our meeting this year. It is a source of great regret to all that he could not join us, and a number of the old-timers joined in a telegram, sent by Mr. Jones, urging his presence—really ordering him to come down. He wired in return to the gentlemen who sent the telegram to him:

"Friends and Fraters: Kindly greetings to you all. It will be impossible under the circumstances to meet with you on this occasion. My hearty and best wishes are yours. Fraternally and eternally,

"T. R. PARKER."

VOTES OF THANKS.

The Secretary—There is one matter I wish to speak of before we close. Votes of thanks by an Association such as this are formal matters, and I am glad to see that, as a rule, we have avoided passing votes of thanks to the readers of papers. There is one vote of thanks, however, that should be passed to day, and that is to the San Francisco Gas and Electric Company. I have had occasion every year to say what I am saying now—that if we did not have the advantages so courteously offered to us by the officers of the San Francisco Gas and Electric Company these meetings would not be anything like the success they have been. Our one trial at Sacramento showed that it meant absolute failure to get away from the environment of this Company, through whose officers and by whose courtesy the members from up country are enabled to learn so much of what they come for. The use of these rooms for the meeting and of the banquet hall above (which is an ideal one), and the many other unusual advantages extended to us, which I am sure you all appreciate as much as I do, are certainly worth a vote of thanks; and it should be, in my opinion, about the only one to be recorded in the proceedings of the meeting. I, therefore, take pleasure in making the motion that the thanks of this Association be extended to the officers of the San Francisco Gas and Electric Company for the favors and courtesies shown this Association.

[The motion was seconded and carried unanimously.]

Mr. Lowe—One more thing before we close. I feel that we should offer Mr. Britton some substantial token of our appreciation of the work that he has done for this Association. It is not child's play to conduct the affairs of an Association of this kind. I know it myself, as Mr. Britton has written me letter after letter to which I paid no attention. If he has had the same kind of a job with the rest of you, I pity him from the bottom of my heart; but for the efforts of Mr. Britton, this Association could not have been what it now is. He has been unceasing and untiring in his work and has received no compensation of any kind. Something more than a mere vote of thanks should be given him. If at any time in the history of an organization faithful and conscientious work is necessary, it is in its infancy, and Mr. Britton has certainly been to this Association all that a parent could be to any child. I, therefore, move you, Mr. President, that a committee be appointed to determine upon some substantial evidence of our appreciation of all that he has done for us.

Mr. Clements—I might speak for more than an hour and say less than Mr. Lowe has; but I assure you I fully appreciate every word Mr. Lowe has said and know full well the interest Mr. Britton has taken in the Association. I take great pleasure in seconding this motion and hope we will have a rising vote.

[The motion was unanimously carried by rising vote.]

THIRD DAY, THURSDAY, JULY 20.

The outing day to Camp Taylor proved more enjoyable than any previous excursion of the P. C. G. A. The day was one typical of the land of sunshine, fruit and flowers. Leaving San Francisco at 9:30 A.M., a delightful 30 minutes' sale down the Bay brought the 110 happy excursionists to Sausalito, where a special train was in waiting. Through the picturesque Ross Valley, skirting the sides of the mount-

ains, through large groves of redwoods, the Camp was reached at 11.30. Boating, fishing, swimming and dancing filled in the time. Luncheon was served at 1 P.M. in the shade of the piney forest. During luncheon a pleasing event occurred, in the presentation to Secretary John A. Britton, by Mr. Leon P. Lowe, on behalf of the P. C. G. A., of an exquisite silver loving cup in appreciation of his seven years of service as its Secretary. Mr. Britton responded in fitting terms. Appropriate toasts were drunk and fealty to the P. C. G. A. renewed. The excursionists reached San Francisco at 6:30 P.M., and their return marked the ending of the Seventh Annual Meeting of the Pacific Coast Gas Association.

Experiments with Paints for Iron.

The following experiments were carried out with a view to determining which of the paints and paint pigments in everyday use in this country are the most suitable for the purpose of painting ironwork, and the most effective in preventing the corrosion of iron under conditions of great severity, says the *Engineer*, of London. It was also desired to ascertain the prejudicial effect, or otherwise, of the use of inert pigments in the paint, such as barytes—barium sulphate—and Paris white or whiting. These bodies have been used for many years in large quantities in the manufacture of paints, and as their introduction makes the paint decidedly cheaper, it is very commonly supposed that such paints are necessarily of a poorer quality than those made simply from a pure color pigment and linseed oil.

The forty-nine paints used in these experiments are similar to those ordinarily made and used, and are not paints specially manufactured for the purpose of painting iron; the pigments were ground with the oil between rollers in the usual way, and in the proportions given below to make a stiff paint. This was afterwards brought to a suitable consistency for painting by mixing with genuine well-boiled linseed oil, capable of drying in seven hours under ordinary conditions of temperature, etc.

It will be seen that in many cases two or three qualities of paint of similar kind have been used, differing only in the proportion of inert pigment which they contain; for instance, Prussian blue paint consists solely of Prussian blue and linseed oil, whilst "A" Prussian blue paint is a cheaper paint containing barytes as a filling material. "B" paints are of a still more diluted character, and "C" contains more barytes, etc., than "B" paints.

In addition to the paints already mentioned a trial was made of barytes alone, ground with oil and used as a paint, and in another case pure boiled linseed oil was used alone. Three sets of 51 iron plates were painted, and after allowing sufficient time for each to become thoroughly dry and firm, they were given a second coat. When this was dry and hard, one set of painted plates was placed out of doors and exposed to the weather. These have been exposed now for 11 months, and are still all in fairly good condition, with the exception of the plate painted with linseed oil, which is much corroded.

The two other sets were treated as follows, and one set was simply to corroborate the results obtained from the other set; it may be said here that the results were practically identical in each case. Each painted iron strip was placed in a clean, wide-mouthed glass bottle half filled with clean, pure water. The bottles were not closed, but were placed side by side on a shelf in the laboratory immediately under the table.

The mouths of the bottles did not quite touch the under side of the table, so that, although there was free access of air to the painted plates, yet dust and other impurities were were kept out. The bottles were allowed to remain untouched for three months. After about a week several of the plates had begun to corrode; this was shown first by a cloudiness in the water, which afterwards became further oxidized and formed a red precipitate of ferric oxide, or rust, which subsided partly to the bottom of the vessel. After the three months' exposure the plates were removed, and the liquid in each bottle, together with the sediment, was carefully tested for the percentage of iron present in the form of rust.

This figure was taken as denoting the amount of corrosion, but in every case is rather below the actual amount, as it does not include the portion which adheres to the iron plate.

In each case the weight of rust found by experiment has been calculated to pounds of rust per 1,500 square feet of painted surfaces, and this amount is set down in the second of the two columns of figures; the first column shows the percentage composition of the various paints employed.

	Per Cent.	Rust from 1,500 Sq. Yards, Lb.
Red lead paint—		
Red lead	88.88	
Raw linseed oil	11.12	none
	100.00	
"A" red lead paint—		
Red lead	45.00	
Barytes	45.00	none
Raw linseed oil	10 00	
	100.00	
"B" red lead paint—		
Red lead	22.00	
Barytes	66.00	none
Raw linseed oil	12.00	none
	100.00	
Orange lead paint—		
Orange lead	88.88	
Raw linseed oil	11.12	none
	100.00	
*Vermilionette paint—		
Barytes	33.33	
Deep vermilionette	44.02	none
Pale vermilionette	14.78	
Raw linseed oil	7.87	
	100.00	
†"Permanent red" paint—		
"Permanent red"	88.88	none
Raw linseed oil	11.12	
	100.00	
Pure zinc white paint—		
Zinc white (zinc oxide)	87.30	
Refined linseed oil	12.70	traces
	100.00	
"A" zinc white paint—		
Zinc white	45.00	
Barytes	45.00	traces
Refined linseed oil	10.00	
	100.00	
"C" zinc white paint—		
Zinc white	27.27	
Barytes	63.63	traces
Refined linseed oil	9.10	
	100.00	
White lead paint—		
White lead	92.56	
Refined linseed oil	7.44	75
	100.00	
"A" white lead paint—		
White lead	53.78	80
Barytes	40.33	
Refined linseed oil	5.80	
	100.00	
Pale oxide paint—		
Pale oxide (ferric oxide about 50 per cent.)	83.60	
Boiled linseed oil	16.40	81
	100.00	
Lithopone paint—		
Lithopone (zinc sulphide, zinc oxide barium sulphate)	87.50	
Refined linseed oil	12.50	90
	100.00	
"C" white lead paint—		
White lead	50.52	
Barytes	42.10	95
Refined linseed oil	7.38	
	100.00	
"A" yellow ochre paint—		
Barytes and calcium carbonate	69.69	

* "Vermilionette" is a pigment composed of orange lead on which has been precipitated about 10 per cent. of eosine.

† "Permanent red" is red lead on which has been precipitated aniline scarlet.

	Per Cent.	Rust from 1,500 Sq. Yards, Lb.
Lead chromate	13.26	107
Turkey umber	2.65	
Raw Linseed oil	14.40	
	100.00	
"A" Venetian red paint—		
Barytes and calcium carbonate	78 80	
Ferric oxide (about 95 per cent. ferric oxide, Fe_2O_3)	8.47	118
Raw linseed oil	12.73	
	100.00	
"C" Venetian red paint—		
Barytes	80.57	
Ferric oxide (about 95 per cent. ferric oxide, Fe_2O_3)	7.55	123
Raw linseed oil	11.88	
	100.00	
Deep oxide paint—		
Deep oxide (about 96 per cent. ferric oxide, Fe_2O_3).	86.89	
Raw linseed oil	13.11	123
	100.00	
Middle oxide paint—		
Middle oxide (about 94 per cent. ferric oxide, Fe_2O_3)	86.89	
Raw linseed oil	13.11	134
	100.00	
Extra bright oxide paint—		
"Pure oxide D" (about 90 per ct. ferric oxide, Fe_2O_3)	82 35	
Boiled linseed oil	17.65	137
	100.00	
Barytes paint—		
Barytes (natural barium sulphate)	88.00	
Raw linseed oil	12.00	155
	100.00	
Pure oxide paint "C"—		
"Pure Oxide C" (ferric oxide about 90 per cent. Fe_2O_3)	76.30	
Boiled linseed oil	23.70	160
	100.00	
"C" celestial blue paint—		
Barytes and calcium carbonate	78.04	
Celestial blue (a form of Prussian blue)	9 74	160
Raw linseed oil	12.22	
	100.00	
"B" Prussian blue paint—		
Prussian blue	22 76	
Barytes	45.52	168
Raw linseed oil	31.72	
	100.00	
Pure middle chrome yellow paint—		
Middle chrome yellow	83.58	
Raw linseed oil	16.42	177
	100.00	
Pure raw sienna paint—		
Raw sienna	74.66	
Raw linseed oil	25.34	197
	100.00	
Pure graphite paint—		
Graphite	69.56	
Raw linseed oil	30.44	215
	100.00	
Pure Prussian blue paint—		
Prussian blue	48.27	
Raw linseed oil	51.73	221
	100.00	
Pure Indian red paint—		
Indian red (ferric oxide about 70 per cent. Fe_2O_3).	82.35	
Raw linseed oil	17.65	227
	100.00	
"A" Vandyke brown paint—		
Vandyke brown	56.00	
Barytes	13.33	239
Raw linseed oil	30.67	
	100.00	
"A" Colcothar paint—		
Barytes and calcium carbonate	60.00	
Oxide of iron	13.93	242
Rose pink (principally barytes)	13.93	
Raw linseed oil	12.14	
	100.00	
"B" Middle oxide paint—		
Barytes	76.22	
Oxide of iron	12.30	244
Raw linseed oil	11.48	
	100.00	
Ivory black paint—		
Drop black (charcoal black)	60.00	
Boiled oil	40.00	250
	100.00	
Turkey red paint—		
Turkey red (about 95 per cent. ferric oxide Fe_2O_3).	81.16	
Raw linseed oil	18.84	262
	100.00	
"A" celestial blue paint—		
Barytes and calcium carbonate	80.56	
Celestial blue	11 83	266
Raw linseed oil	7.61	
	100 00	
"B" Chinese blue paint—		
Chinese blue (another form of Prussian blue)	22.76	
Barytes	45.52	275
Raw linseed oil	31.72	
	100.00	
"A" Italian ochre paint—		
Italian ochre	38.74	
Barytes	19.00	296
Raw linseed oil	42.26	
	100 00	
"A" middle Brunswick green—		
Barytes and calcium carbonate	69 99	
*Superior middle Brunswick green	18 24	309
Raw linseed oil	11.77	
	100.00	
"C" middle green paint—		
Barytes	78 32	
Superior Brunswick green	9.79	322
Raw linseed oil	11.89	
	100.00	
"A" Oxford ochre paint—		
Barytes and calcium carbonate	63.07	
Chromate of lead	22 51	326
Umber	3.31	
Raw linseed oil	11.11	
	100.00	
English umber paint—		
English umber	57.51	
Raw linseed oil	42.49	326
	100.00	
"A" black paint—		
Barytes and calcium carbonate	68 99	
Ivory and carbon black	8.42	352
Manganese dioxide	2.46	
Boiled linseed oil	20.13	
	100.00	
Burnt Turkey umber paint—		
Bunt Turkey umber	59.20	
Raw linseed oil	40.80	353
	100.00	
"C" yellow ochre paint—		
Barytes and calcium carbonate	79.28	

* A mixture of lead chromate and Prussian blue.

	Per Cent.	Rust from 1,500 Sq. Yards, Lb.
Chromate of lead	8 31	369
Raw umber	1 72	
Raw linseed oil	10 69	
	100 00	
"C" black paint—		
Barytes and calcium carbonate	79.30	
Carbon and bone black	4.35	392
Manganese dioxide	1.30	
Raw linseed oil	15.05	
	100.00	
Middle purple brown paint—		
Barytes and calcium carbonate	62.52	
Oxide of iron (ferric oxide)	27.03	398
Raw linseed oil	10.45	
	100.00	
"A" ultramarine paint—		
Ultramarine	52 63	
Barytes	26.32	425
Raw linseed oil	21.05	
	100.00	
Burnt sienna paint—		
Burnt sienna	56 00	
Raw linseed oil	64.00	439
	100 00	
Chinese blue paint—		
Chinese blue	48.27	
Raw linseed oil	51.73	441
	100.00	
Boiled linseed oil—		
Boiled linseed oil		500
Raw Turkey umber paint—		
Raw Turkey umber	51.85	
Raw linseed oil	48.15	510
	100.00	

These results show very clearly the immense superiority possessed by paints containing red lead pigments when applied to iron surfaces which are partly immersed in water; zinc oxide runs the red lead very close as a protective pigment, and the others follow in order of merit.

The paint composed of barytes and oil takes a far higher position in the list than many people would suspect, and this leads one to look upon the use of this material as less of an adulteration than has commonly been assumed; indeed, in the case of some paints containing pigments of low efficiency the addition of a large quantity of barytes is actually a great improvement, as in the case of Chinese blue, celestial blue and Prussian blue, but with pigments of high protective value, such as red lead, zinc oxide and white lead, the addition of barytes is not to be recommended.

A serious disadvantage possessed by all paints containing red lead is their tendency to solidify, owing to the formation of a compound of the lead with the linoleic acid of the oil, so that it is necessary to use such paints soon after they are made. If the first coat of red lead paint can be applied to the iron, it is probable that the remaining coats might be of some other paint of a less obtrusive color with almost equally good results; for instance, the second and third coats might be a good oxide of iron paint—pale oxide paint—which forms a good tough film when dry, and is well calculated to protect the first coat from possible abrasions.

A further series of experiments was made by painting the inside of a number of circular iron trays with the same paints as were used for the plates. The trays measured 5 inches wide by ½ inch deep, and were painted twice. When the last coat was quite dry and hard the trays were all filled to the brim with water and allowed to remain untouched until the water had completely evaporated, when they were refilled. During the three months each tray was filled and dried six times, and they were then examined.

In most cases all traces of paint had disappeared, and a thick deposit of rust was found, but the trays painted with the following mixtures were all in very fair condition:

Red lead paint. A. Red lead paint. B Red lead paint. Orange lead paint. Vermilionette paint. Permanent red paint.	These were all practically unaffected.
Zinc white paint. A. Zinc white paint. C. Zinc white paint. Lithopone paint. White lead paint. A. White lead paint. C. White lead paint.	All these were slightly rust-stained, and are placed strictly in order of merit.

It will be seen that very much the same results were arrived at as in the bottle experiments, although the conditions were so widely different.

On the Electrolysis of Thiosulphate of Ammonium.

By M. P. Pierron.

It has been recently proposed to introduce hyposulphites into the electrolysis of certain electro-metallurgical operations; it therefore seemed to be of importance to decide what transformations these salts may undergo under the influence of the electric current.

The experiments were carried out on aqueous solutions of thiosulphate of ammonium containing 17.5 per cent. of the anhydrous salt. The action at the two poles was examined separately. The solution submitted to electrolysis was contained in a porous pot; a cylindrical platinum electrode was suspended therein; the other electrode, of lead, surrounded the pot, and was plunged into a 10 per cent. solution of carbonate of ammonium; when the outer electrode is the anode there would be no inconvenience in replacing this solution by hyposulphite; when, however, it is the cathode, the hyposulphite would give sulphides by reduction, and these would carry HS— or —S— ions into the interior of the pot, and thus complicate the phenomena. The temperature was kept at about 15° by means of a cold water jacket; platinum was first used as the cathode.

The density of the current at the cathode was from 10, 25 to 40 amperes per decimetre; the phenomenon of reduction always led to the formation of sulphide of ammonium; no other product of this action was detected, and the phenomenon was not examined any closer.

If the inner electrode is the anode the reactions are more complex; we should expect then to form some of the acids of the thionic series; the methods of Fordos and Gélis has been applied to their detection. The sulphuric acid formed was estimated in the state of sulphate of barium; an iodometric titration gives the total reducing power of the sulphurous acid and of the unchanged hyposulphite; this treatment with iodine transforms the sulphites into sulphates; a fresh estimation of the sulphuric acid will thus give the proportion of sulphurous acid present; this known, it is easy to deduce from the reducing power the proportion of theosulphuric present.

A current of chlorine in alkaline solution transforms all the oxidised compounds of sulphur, with the exception of dithionic acid, into sulphuric acid; this is estimated, and we thus obtain the quantity of sulphur present in the three last thionic acids; finally, by evaporating to dryness, mixing the residue with three times its weight of chlorate of potash, and treating with hydrochloric acid, all the sulphur passes to the state of sulphuric acid; a final titration of this latter gives, by difference, the proportion of dithionic acid. In the experiments we made these two last determinations led to identical results. On the other hand, ammoniacal nitrate of silver is not clouded by the electrolyzed ammoniacal solutions—they hardly color it brown—therefore they do not contain pantathionic acid. Under these conditions we can determine the trithionic and tetrathionic acids; the neutral solution is boiled with excess of mercuric cyanide until it is no longer cloudy.

The SO_3H groups contained in the various salts of the solution are thus transformed into sulphates; the remainder of the sulphur is eliminated in the state of sulphide of mercury, or set at liberty. The sulphuric acid is estimated; from the figure found after the deduction of the quantity of sulphuric acid coming from the other acids (sulphuric, sulphurous, hyposulphurous) the quantity of sulphur contained in the thionic acids is deduced. Let P_1 be this weight of sulphur; P_2 the total thionic sulphur; if p_3 is the weight of sulphur contained in the existing trithionic acid, $2p_3$ will be the weight contained in its SO_3H groupings; in the same way if $4p_4$ is the weight of the total tetrathionic sulphur, $2p_4$ will be the weight contained in the tetrathionic SO_3H groupings, from whence we obtain the equations—

$$P_1 = 2p_3 + 2p_4,\ P_2 = 3p_3 + 4p_4,$$

from which we have—

$$p_4 = \frac{P_1 - 2p_3}{2},\ \text{and}\ p_3 = 2P_1 - P_2.$$

(All these weights are expressed in sulphur.) In this manner considerable quantities of tri and tetra-thionic acids are detected.[1]

In 200 c.c. of the thiosulphuric solution currents of 28 ampere hours have been passed at densities of 40, 15 and 3 amperes per square deci meter (the current used was 1.1 ampere), at a temperature of from 12 to 16°. From the commencement and during the whole time sulphur is deposited, and sulphurous anhydride given off; in an experiment at 40 amperes density this sulphur adhered strongly to the platinum, increased the resistance of contact, and caused a decided elevation of temperature of the electrode; the conditions of the experiment were thus slightly different from those of the other experiments. In all three cases the electrolyte became acid.

The method of analysis described above gave the following results:

Density at the Anode.	40 Amperes per Decim.	15 Amperes.	3 Amperes.
S deposited	15.20	9.62	5.16
S sulphuric	7.20	5.92	5 32
S sulphurous	1.21	1.30	1 07
S trithionic	2.81	1.35	2.87
S tetrathionic	3.99	5.70	8.71

From these figures we get the increase of the deposit of sulphur and of the quantity of sulphuric acid with the density of the current, and the simultaneous diminution of the tetrathionic acid. The proportion of sulphurous acid remains practically constant; that of trithionic acid shows a variation which is not easy to explain by reason of the complexity of the phenomena; as to its presence, it was foreseen from the work of Plessy and Rathke. The hyposulphite is here found in the presence of sulphurous acid and of acid sulphite. It is easy to understand, on the other hand, the inverse variation of the quantities of tetrathionic acid, sulphuric acid, and deposited sulphur. The tetrathionic acid evidently here results from oxidation, and not from addition, as, for example, persulphuric acid; the diminution of returns at high current densities proves this, and, further, for this addition to be possible it would be necessary for the sulphydric atoms, —S— (SO_3H), to take a prominent part in the electrolysis, and be consequently more easily dissociated than the other, which is extremely probable in the concentrated solution submitted to electrolysis. At the commencement, then, of the electrolysis, some of the ions $—SO_3.S.NH_4$ are set at liberty, and split up into sulphur, sulphurous acid and sulphate of ammonia:

$$(2[NH_4.S.SO_3—] = SO_2 + S_2 + SO_4(NH_4)_2).$$

This latter immediately takes part in the electrolysis, forming sulphuric acid, which makes the solution acid, and oxygen, which transforms the thiosulphate into tetrathionate. If the surface of the electrode is large, at the end of a few moments the sulphate is electrolyzed almost alone, being the most easily dissociated of the salts in solution, and the phenomenon of oxidation to tetrathionate goes on. If the surface is small, the electrolyte in its neighborhood will become poor in sulphuric ions and the thiosulphate will continue to be electrolyzed, giving sulphate, sulphur and sulphurous acid; the return of tetrathionate, which is in direct relation with the quantity of sulphuric ions given off, diminishes accordingly. Besides these phenomena, an oxidation of sulphurous acid takes place, and possibly an oxidation of the thionic acids which does not allow of uniformity between the two sets of reactions; what leads to this last supposition is, that in the electrolyzed solutions we do not find either pentathionic acid or sulphureted hydrogen, which ought to be present as products of the decomposition of the hyposulphite under the slow influence of the sulphuric acid set at liberty.

Small quantities of the former have been detected in the early part of the electrolysis, but they gradually disappear. It is thus evident that these bodies are destroyed during their formation by the oxidizing action of the surrounding material, and the other thionic acids—although having greater resistance—should be equally destroyed. These products of the destruction of the hyposulphite are evidently oxidized at the expense of forming tetrathionate; by checking the acidity of the solution by adding ammonia during the electrolysis, we could diminish the formation of tetrathionate, and the deposit of sulphur, and the formation of sulphuric acid; experiment has confirmed this view. But the experiments made in this direction were not sufficiently exact to give very good results.

1. P might be measured by determining the total alkali, after exactly neutralizing the solution. In fact, ammonium, NH_4, corresponds in the series to an SO_3H grouping.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. ARTHUR DREW, Secretary and Treasurer of the Electric Gas Lighting Company, died on the steamship "Catalonia," while returning home from a trip to Europe. His death occurred on the 16th ult., and his body was buried at sea. Deceased was born in Boston, Mass., December 12, 1842, and in his birthplace his life was passed. He had been Secretary and Treasurer of the Electric Gas Lighting Company, the headquarters of which are in Boston, for several years.

THE proprietors of the Cambridge (Mass.) Gas Light Company have purchased a large plot of ground, fronting on Monroe and Athenæum streets.

WE are informed that the Schuylkill Consolidated Gas Company has been incorporated by Messrs. F. H. Shelton, F. C. Horton, C. R. Miller, J. D. Shattuck and D. J. Collins, for the purpose of supplying gas for light, heat and power to Phoenixville, Spring City, and adjacent boroughs in Pennsylvania.

A RECENT issue of the Lockport (N. Y.) *Union* says that the Lockport Gas and Electric Light Company has completed arrangements for the delivery to it of Niagara Falls power, which will be brought to the city over the lines of the Buffalo and Lockport street railway. The amount contracted for is in the neighborhood of 200-horse power. The present capacity of the plant is about 50-horse power. The additional power has been made necessary by the fast increasing demand for electrical power to operate the many small motors in the city.

A VERY queer suit has been brought against the Bristol (R. I.) County Gas and Electric Company by Myles Fitzmaurice. Plaintiff asserts that, on the night of July 25, 1899, one of the wires of the company leading to the house of Mary E. Dyer, of Rumstock Point road, broke and fell upon a wire netting which formed part of a wire fence enclosing a hen house. The netting became charged with electricity, and plaintiff, in attempting to discover the cause of the disturbance, also "became so charged" with the current that "his nervous system is now seriously affected." He thinks $1,000 will about repay him for the shocks sustained.

THE Electric Lighting Company, of Columbus, Miss., and the Columbus Gas Light Company have agreed to consolidate their interests, the amalgamation to be formally perfected October first. The new concern is to have a capitalization of $40,000, and if the present intention of those in charge is carried out, the gas works will be rebuilt this winter.

THE Essex and Hudson Gas Company, of Newark, N.J., proposes to extend its mains through the township of Belleville.

PRESIDENT ANDREW HICKENLOOPER, of the Cincinnati Gas Light and Coke Company, has issued the following announcement respecting the new ordinance regulating gas rates in that city, mention of which ordinance has been made in the JOURNAL:

"The ordinance recently passed and certified to this Company, the 16th of August, reducing the price to be charged for gas to 75 cents per 1,000 cubic feet for that used for illuminating purposes, and to 50 cents for gas supplied through a separate service and meter for fuel purposes having been this day accepted, the public is hereby notified that such change in price to be charged for illuminating gas will go into effect from and after August 31. Notice is also given that from and after such date the Company will be prepared to receive applications for separate service connections for supply of gas to be used exclusively for fuel purposes, which connections will be inserted as rapidly as possible, and in the order in which applications are made under detailed conditions, rules and regulations which are now being prepared, and will, at the earliest practicable date, be printed in pamphlet form for the information and guidance of architects, owners, consumers and gasfitters."

THE Union Metallic Cartridge Company, of Bridgeport, Conn., has placed an order with the Berlin Iron Bridge Company, of East Berlin, Conn., for an extension to its 3-story factory building on Barnum avenue, and to connect the same with a bridge across Barnum avenue to a factory building on the opposite side of the street.

MR. SAMUEL HUMELL has been appointed Superintendent of the Waynesburg (Pa.) Gas Company.

Miss J. Guss Ditting has assumed the management of the Hollidaysburg (Pa.) Gas Company.

This is from a recent issue of the Chicago *Tribune:* "This bill isn't what I had a right to expect," grumbled the man who had stepped up to the cashier's window at the gas company's office. "Two dollars, hey?" said the cashier, glancing at the bill. "That doesn't seem so very exorbitant. What was it the month before?" "Four dollars." "You didn't kick on that, did you?" "No." "Why is this so much smaller?" "The house was shut up half the month." "Then what are you complaining about? Isn't $2 about right?" "Yes; but, blame it, I made a bet of $5 the other day that the bill would be as big as usual!"

The proprietors of the Hamilton (Ohio) Gas and Coke Company, through its President, Mr. C. W. Andrews, have made a proposition to the authorities of Hamilton looking to the joint operation of the city's gas and electric light plants by the former. The terms of the proposition are:

"1st. The undersigned Company [the Hamilton Gas and Coke Company] under an operating agreement will assign and take full charge of the city's gas plant in connection with its own, and of the manufacture, sale and distribution of the gas supply in the city of Hamilton, and for the city's share of the profits of the joint enterprise will pay annually into the city treasury the receipts from the sales of gas in the city by the combined plants, in excess of 70 cents per 1,000 cubic feet of gas, and in addition will furnish gas for 200 street lamps free of charge, leaving the city to determine whether such excess shall be given to gas consumers direct in cheaper gas, or be paid into the city's treasury for the purpose of reducing taxation.

"2d. The undersigned Company to make all extensions and betterments which may be necessary from time to time for the supply of the city and its inhabitants with gas.

"3d. The undersigned Company to give suitable bond for carrying out its part of the said agreement, and for the return to the city of its plant in good condition when required to do so.

"4th. The said combined operation to extend for a period of 30 years, unless sooner terminated according to law, for nothing in this agreement shall be construed as in any way affecting the right of the city to purchase the plant and franchises of the undersigned Company under the provisions of the laws of Ohio on that subject at any time during the said 30 years.

"5th. The undersigned will further agree to secure from the Hamilton Electric Light Company a similar agreement, whereby the city shall obtain control of the machinery and franchises of said, the Hamilton Electric Light Company, and of the exclusive manufacture, sale and delivery of electricity for light and power purposes, paying that Company 10 per cent. of the gross receipts therefrom, exclusive of the lighting of the streets and public buildings, as its share of the profits of the joint enterprises. The city is now operating its plant chiefly for the purpose of lighting the streets, having little demand for power purposes during the daytime. The combining of these two plants in operation would transfer to the city plant the large day load of the Hamilton Electric Light Company for power purposes, thereby resulting in a great saving in the cost of production, and thus putting the city's electric plant on a sound financial basis and making further increases in the taxes levied for its benefit unnecessary. The result to the city of the working arrangements as to the various plants hereinbefore suggested would be substantially as follows:

"1st. The city would receive an annual income from gas works of $10,000, of which $7,000 would be in cash and $3,000 in gas, with the future annual cash increase of at least $1,000, taking the increase of the last two years as a basis, which cash receipts would be sufficient to pay the annual interest on the gas bonds and provide a sinking fund for their redemption.

"2d. The increase of the net income of the city from sales of electricity for light and power purposes, resulting from said combined operation by the city, would be at least $6,000 annually, which would not only pay the above percentage to the said Company as its share of the profits, but also the full interest on the electric bonds.

"3d. The highest development and efficiency of the combined plants, under favorable conditions, with the right of acquiring at any time exclusive ownership by the city, should it desire so to do.

"Should the above suggestions and the objects sought to be attained thereby be deemed of sufficient importance for the consideration of your Honorable Board, we shall be pleased to take up the matter in more detail with a Committee of your Board, at such time and place as you may indicate."

The Massachusetts Board of Gas and Electric Light Commissioners will hold the first hearing, in the matter of the application of the Edison Electric Illuminating Company, of Boston, for the right to issue new capital stock sufficient to produce $750,000 in cash, at the State House, Boston, at 10 A.M. of the 5th inst.

The Baltimore *Sun* says that the syndicate which recently purchased the plant and franchises of the Hagerstown (Md.) Gas Light Company will not take actual possession thereof until the 1st prox. It is said that the price paid for the stock was $60 per share, its par value being $20 per share.

Mr. J. West Martin, ex-Regent of the University of California, and for many years President of the Oakland (Cal.) Gas Light Company, died at his home in San Francisco, the morning of August 19th. He was in his 77th year.

A correspondent in Portland, Me., writing under date of August 25th, says: "The Portland Gas Light Company will make a determined effort to secure a portion of the public street lighting of the city by means of Welsbach incandescent gas lamps. The experimental test or trial of the lamps, which was carried out on a fairly extensive scale on Congress street, has proved most satisfactory in every respect. The bids for the public lighting will be opened the afternoon of September 1st."

A correspondent incloses the following clipping from a recent issue of the Chicago *Record:* "Without saying much about it the Peoples Gas Light and Coke Company is about to enter into undisputed possession of a territory which is expected to add 10,000 meters to its service. A big main has been laid from the Grand Crossing plant to the Kensington region, and, on the authority of President Billings, it is announced that light and fuel gas will be available in Kensington, Roseland, West Pullman and intermediate, territory within 10 days. As soon as connection can be made between the old mains of the Pullman plant and the People's new mains the plant recently purchased will be dismantled. It is expected that the junction of the systems will be at 110th street and Michigan avenue. To show the magnitude of the work which has been done without attracting any public notice it is officially stated that the Company has laid 16 miles of new mains as follows: Four miles of 16 inch, three miles of 12-inch and the remainder divided between 8 and 6 inch mains. The territory occupied is shown by the route of the new lines: Starting at the South Chicago avenue works the main feeder follows 73d street to Cottage Grove avenue, thence to 95th street, thence east 300 feet to the continuation of Cottage Grove avenue, thence south to 103d street, thence west to Michigan avenue, down Michigan avenue to 119th street, thence to Halsted street and down Halsted street to 121st street. This extension is expected to put an end to the efforts of those behind the West Pullman land association to secure a franchise for a gas business in that region. What is even more to the liking of the People's Company, it promises to increase enormously the fuel gas business, to which the Company looks for augmented profits. With reference to the earnings of the People's Company information is eagerly sought and hard to get. The published reports for last year showed somewhat better than 6 per cent. earned on the stock and 6 per cent. was paid in dividends."

The Spokane Falls (Wash.) Gas Light Company has been having trouble with the local plumbers, and the trouble finally culminated in the latter refusing to do any work at all for the Company. In explaining the situation, Secretary and Manager Aldrich, of the Gas Light Company, said to the representative of a local paper:

"We originally went into the piping business against our will and are perfectly willing to give it up provided we can assure our patrons that the work will be well done. We found the unions of the city arrayed against us and threatening to do no work on buildings which were piped for gas. Our Company would not stand by and see property owners prevented from piping their houses for gas while they were being built; and so we made the offer to finish any house without delay on which there should be a strike on account of the gas piping. One thing, however, we insist upon, and that is the right to run our own business. We will never allow a union man to work for us. Our offer to compromise is made in the spirit of restoring harmony, and if the plumbers accept we will not be forced to more drastic measures. We also retain the right to supervise all gas piping put in the houses. We will reject any work that is not up to the standard and constructed under correct rules of hygiene. The Company is awaiting an answer before deciding upon any other plans for the protection of property owners here; but we are determined that the building boom which now seems to be in Spokane shall not be stopped for want of labor."

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, SEPT. 4, 1899.

Test of a Nordberg Pumping Engine.

Some time ago the Nordberg Manufacturing Company, of Milwaukee, Wis., built a pumping engine on the Wildwood pumping station of the Pennsylvania Water Company, at Pittsburg, Pa. To determine its capacity all round the series of exhaustive tests, made by Prof. R. C. Carpenter (Cornell University, N.Y.), show that its consumption of dry steam, per indicated horse power per hour was 12,263 pounds, and that the British thermal units of heat, per indicated horse power per minute, were 185.96. The duty of the pump per million British thermal units which the steam supplied to the engine in excess of the feed water returned to the boiler was 162,948,824 foot pounds, and the duty per 1,000 pounds of dry steam 150,254,138 foot pounds. The contract provided for 110 million foot pounds per million thermal units, and this was greatly exceeded. The engine is of the quadruple-expansion type, with cylinders 19.5 ins., 29 ins., 49.5 ins., and 57.5 ins., in diameter, with a stroke of 42 ins. The pump cylinders are two in number, each 14 75 inch in diameter by 42 inch stroke. The boiler pressure is 200 pounds per square inch, and the piston speed 250 feet per minute. The valve gears are of the Cornish type, except the exhaust valves on No. 3 cylinder, which are single-beat poppet valves, and all the valves on No. 4 cylinder, which are also single-beat poppet valves. The most noticeable feature of the engine is the arrangement for heating the condensed steam on its way from the hotwell to the boiler. A surface condenser is employed which is kept at a low temperature by large quantities of circulating water. The condensed steam is delivered by the air pump into a hotwell, from which it is pumped into an oil-purifying tank at a high level. From this tank the feed water passes to a heater in which it falls in drops over shelves through the ascending current of exhaust steam from the low pressure cylinder; this heater is under the same vacuum as the condenser, and is termed the exhaust or preheater. The water discharged from the preheater is pumped into heater No. 1, which is of similar construction to the preheater, heat being taken from the low pressure cylinder, however, for warming the feed water. The steam is drawn into the heater through a pair of auxiliary valves in the low pressure cylinder; these valves are opened at about seven-eighths of the stroke and after cut off. From heater No. 1 the water is discharged into heater No. 2 by gravity. In heater No. 2 the feed water is further warmed by discharge of steam from receiver No. 3. The water is then pumped from heater No. 2 to heater No. 3, where it is warmed by steam from receiver No. 2, and by the jacket discharge from cylinders No. 3 and 4. It is then pumped to heater No. 4, where it is further warmed by steam from receiver No. 1, and by the discharge of water from the jackets of cylinders No. 1 and 2, and the reheaters of the receivers.

Starting with water in the outside tank at 88°, it is raised in the exhaust heater to 105°, in heater No. 1 to 136°, in heater No. 2 to 193°, in heater No. 3 to 260°, and in heater No. 4 to 311°. The various cylinders are jacketed on the barrels, and the receivers between the cylinders are provided with reheating pipes. The indicated horse power during the test was 712. At a test made without heaters the consumption dry steam was 11.4 lbs. per indicated horse power per hour, the duty was 147,525,550 foot pounds per 1,000,000 B.T.U. supplied, and a duty of 159,824,700 per 1,000 lbs. of dry steam. It will be noted that the effect of the heaters is to increase the duty from 147.5 to nearly 163 millions, an amount slightly over 11 per cent. The withdrawal of steam for use in the heaters, on the other hand, reduced the duty on the basis of 1,000 pounds of dry steam used by the engine in the ratio of 160 to 150. This computation would indicate that the gain from the use of the heaters was not compensated for by the higher economy in steam consumption of the engine when running without the heaters, or, in other words, that there is a distinct gain in using the heat of steam, which has done some work, in raising the temperature of feed water.

The Market for Gas Securities.

The situation in respect of the market for city gas shares is, to say the least, surprising. The New Amsterdam Company, which is selling gas at any price that it can get, shows a rise on its shares during the trading for the week, and the Consolidated Company, which has just cut its dividend to a rate of 4 per cent. per annum, looks over a gain to its values of 8 points in the week's trading. It is quoted to-day (Friday) at 190½ to 191 ex.-div. of 1 per cent., and the short interest in it has not yet been closed. The signs are that a restoration of rates is about to be concluded, which conclusion should be heartily welcomed by the Rogers-Jordan combination.

Brooklyn Union is not as strong as it should be, although it has recovered some from its relapse. Now or never is its date. It looks like tempting death to advise the purchase of Bay State, but the advice is given. Baltimore looks a buy, and so does Laclede common. Another seemingly good thing on the list is the Northern Union bond issue, first fives, at the quoted rates.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

SEPT. 4.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	192	193½x
Central Union, Bonds, 5's.	3,000,000	1,000	107½	108½
Equitable Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	260	
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.		
New Amsterdam Gas Co.	13,000,000	100	24½	25
Preferred	10,000,000	100	58½	60
Bonds, 5's	11,000,000	1,000	100½	101
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000		112	114
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000		
Standard	5,000,000	100	112	115
Preferred	5,000,000	100	134	138
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	143¾	143
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1⅞	2
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	40	
" 1st Mtg. 5's	450,000	1,000	95	98
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	68	71
Buffalo City Gas Co.	5,500,000	100	8	9½
" " Bonds, 5's	5,250,000	1,000	84	85
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	70	75
1st Mortgage	1,207,000	1,000	106	108
Consumers. Jersey City	2,000,000	100	95	.
" Bonds	600,090	1,000	107½	110
Cincinnati G. & C. Co.	8,500,000	100	191½	192
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Consolidated, Baltimore	11,000,000	100	63½	63¾
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000		..	112
Consolidated Gas Co. of N.J.	1,000,000	100	21	23
" Con. Mtg. 5's	380,000	1,000	87	90
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	99	99½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	99	99½
" Inc. 5's	31,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	77	83
" Bonds	2,000,000	..	80	85
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	220
Indianapolis	2,000,000	..	122	128
" Bonds, 6's	2 650,000	..	105	106
Jackson Gas Co	250,000	50	50	..
" 1st Mtg. 5's	250,000	1,000	96	100
Jersey City	750,000	20	225	235
Lafayette Gas Co., Ind.	1,000,000	100	68	70
Bonds	1,000,000	1,000	81	86
Louisville	2,570,000	50	106	108
Laclede, St. Louis	7,500,000	100	65	68
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	107	108
Madison Gas & Elec. Co.	400,000	100	82	85
" 1st Mtg. 6's	350,000	1,000	102	.
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	16,000,000	..	50	60
Bonds, 6's	4,600,000	..	107	108
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53½	55
" Bonds	750,000	..	..	.

Peoples G. L. & Coke Co., of Chicago	25,000,000	100	120	120⅜
People's Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅛	112
2d "	2,500,000	1,000	104	105
People's, Jersey City	500,000	50	215	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87⅛	90
San Francisco, Cal.	10,000,000	100	70	73
St. Paul Gas Light Co.	1,500,000	100	50	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1.000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96	99
Syracuse, N. Y.	1,750,000	100	..	13
Bonds	1,612 000	1,000	81	84
Washington, D. C	2,600,000	20	280	..
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	99	100
Bonds, 5's	3,880,500	.	106	108
Wilmington, Del.	600,000		214	..

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A Man to Repair Meters, put in Service Pipe, etc.

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Not Expensive. Write to

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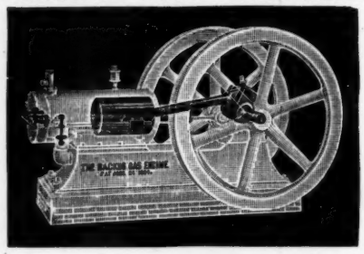

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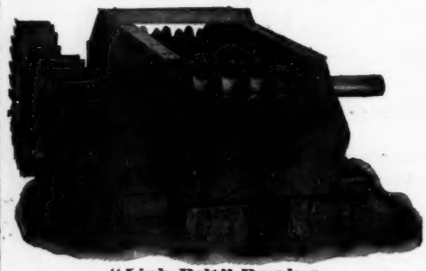

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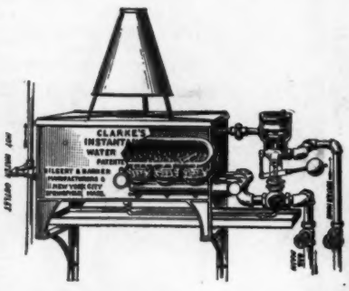

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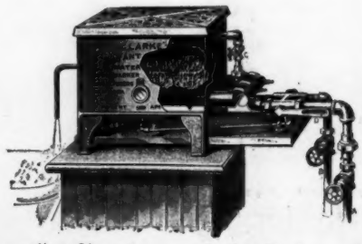

This **INSTANTANEOUS WATER HEATER** is not automatic. *A* is the gas pipe; *B* the water supply pipe; *E* the pilot light; *D* is a double cock by which both gas and water are controlled by *one movement*. The flow of water is adjusted by the cock *C*, so that *live* steam may be discharged in *thirty seconds*, or hot water as desired.

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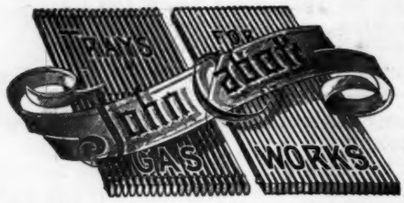

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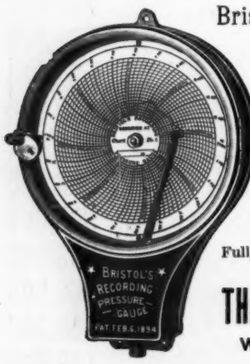

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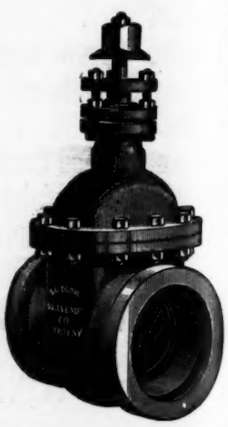

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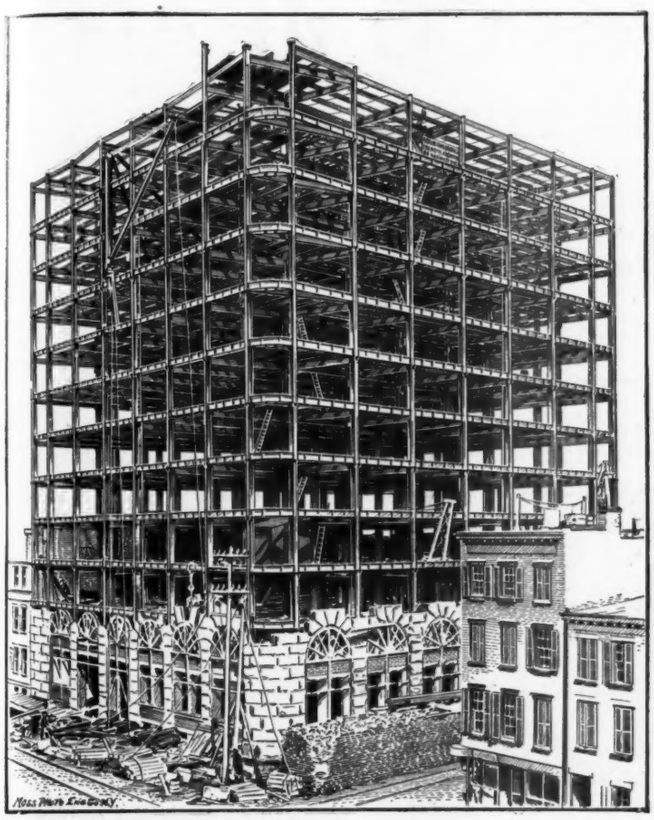

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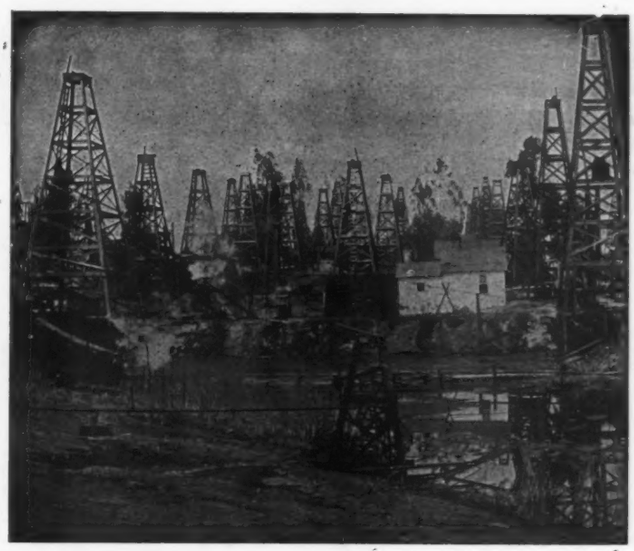

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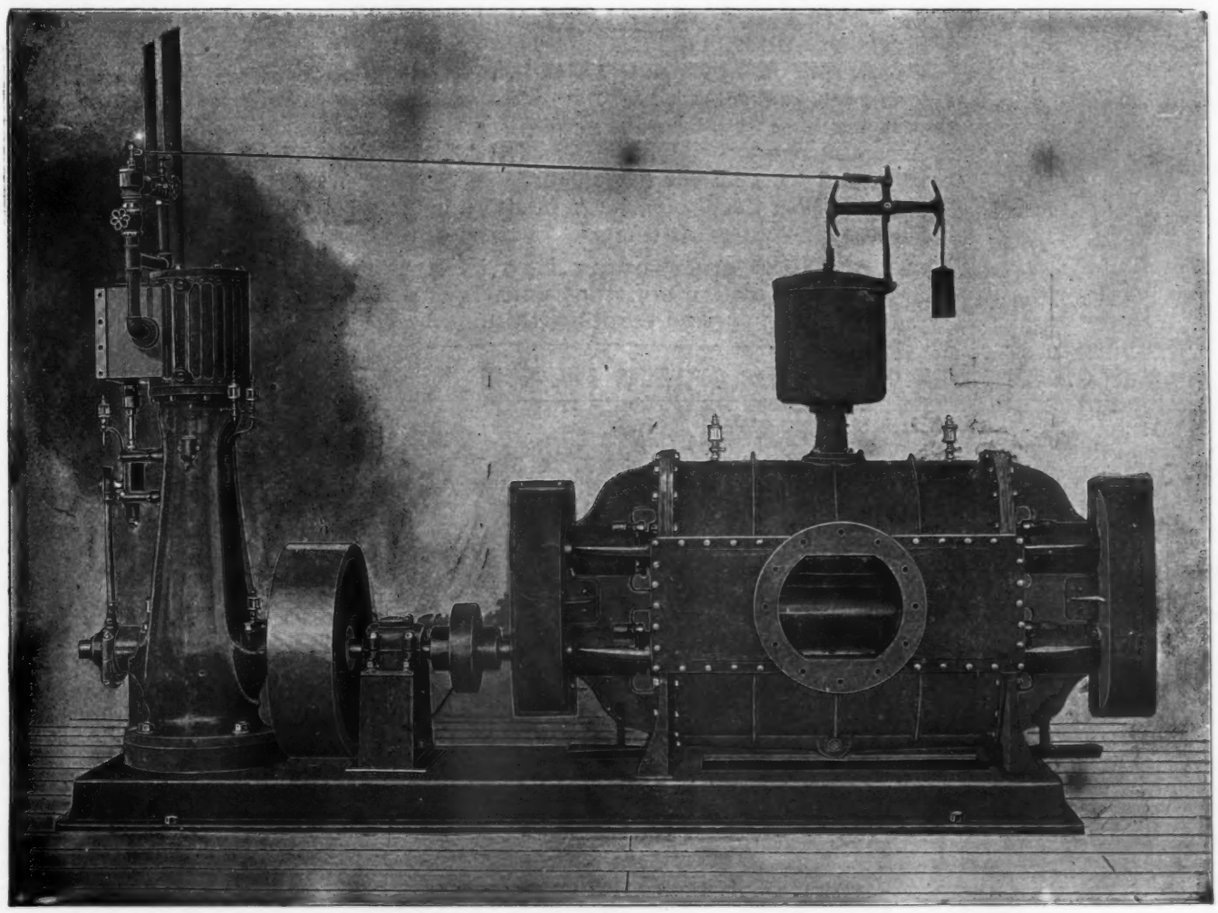

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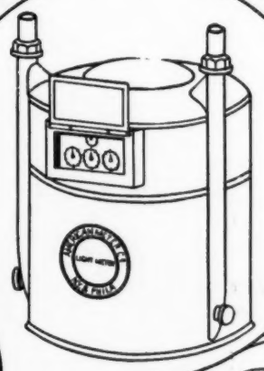

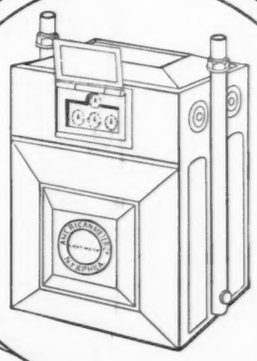

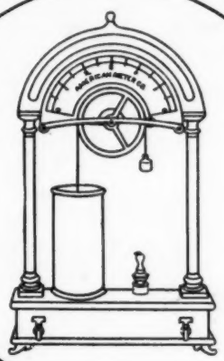

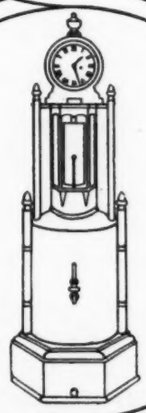

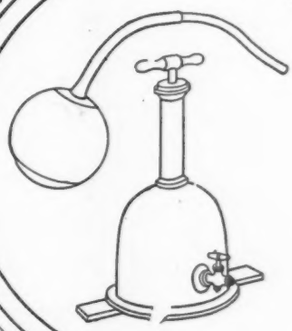

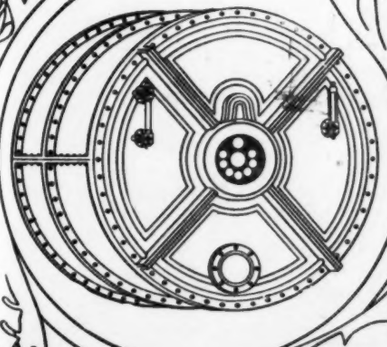

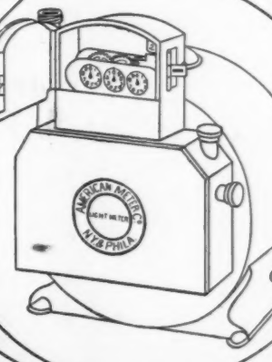

PUBLIC LIGHTING TABLE.

SEPTEMBER, 1899.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Fri.	1	7.10 PM	4.30 AM	6.30	4.20
Sat.	2	7.10	4.30	6.30	4.20
Sun.	3	7.00	4.30	6.15	4.30
Mon.	4	7.00 NM	4.30	6.15	4.30
Tue.	5	7.00	4.30	6.15	4.30
Wed.	6	7.00	4.30	6.15	4.30
Thu.	7	7.00	4.30	6.15	4.30
Fri.	8	7.00	4.30	6.15	4.30
Sat.	9	7.10	4.30	6.15	4 30
Sun.	10	7.50	4.40	6.05	4.40
Mon.	11	8.40	4.40	6.05	4.40
Tue.	12	9.40 FQ	4 40	6.05	4.40
Wed.	13	10.40	4 40	6.05	4.40
Thu.	14	11.50	4.40	6.05	4.40
Fri.	15	1.00 AM	4.40	6.05	4.40
Sat.	16	2.20	4.40	6.05	4.40
Sun.	17	3.40	4.40	5.55	4.50
Mon.	18	No L.	No L.	5.55	4.50
Tue.	19	No L. FM	No L.	5.55	4 50
Wed.	20	No L.	No L.	5.55	4.50
Thu.	21	6.30 PM	8.00 PM	5.55	4.50
Fri.	22	6.30	8.40	5.55	4.50
Sat.	23	6.30	9.20	5.55	4.50
Sun.	24	6.20	10.10	5.40	5.00
Mon.	25	6.20	11.00	5.40	5.00
Tue.	26	6.20 LQ	12.00 AM	5.40	5.00
Wed.	27	6.20	1.00	5.40	5.00
Thu.	28	6.20	2.00	5.40	5.00
Fri.	29	6.20	3.00	5.40	5.00
Sat.	30	6.20	3.50	5.40	5.00

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150.30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45

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LOWE WATER GAS APPARATUS.

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	SETS.	DAILY CAPACITY.
Fostoria, O.	1	250,000 Cubic Feet.
Derby, Conn.	1	750,000 "
Lowell, Mass.	1	1,000,000 "
Doylestown, Pa.	1	50,000 "
Darby, Pa.	1	400,000 "
Adrian, Mich.	1	125,000 "
Concord, N. H.	1	400,000 "
Sioux City, Iowa	1	750,000 "
Standard Gas Light Co., New York	3	5,400,000 "
Peekskill, N. Y.	1	250,000 "
Westchester, N. Y.	1	250,000 "
Jersey City, N. J.	1	1,000,000 "
Stapleton, N. Y.	1	750,000 "
London, O.	1	125,000 "
Chicago, Ills.	2	3,600,000 "
Putnam, Conn.	1	125,000 "
Mansfield, O.	1	250,000 "
Plymouth, Pa.	1	125,000 "
Athens, Pa.	1	125,000 "
Charlotte, N. C.	1	250,000 "
Total	23	15,975,000 "
Previously built	294	187,100,000 "
Grand Total	317	203,075,000 "

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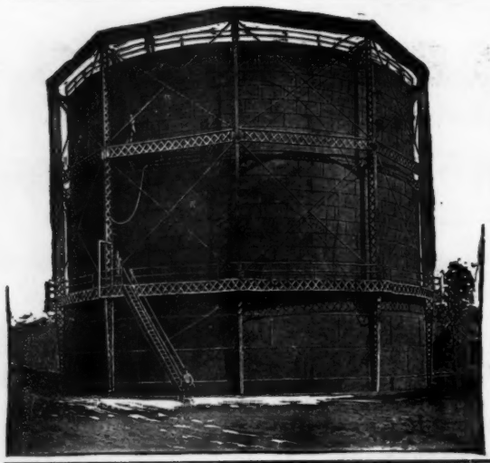

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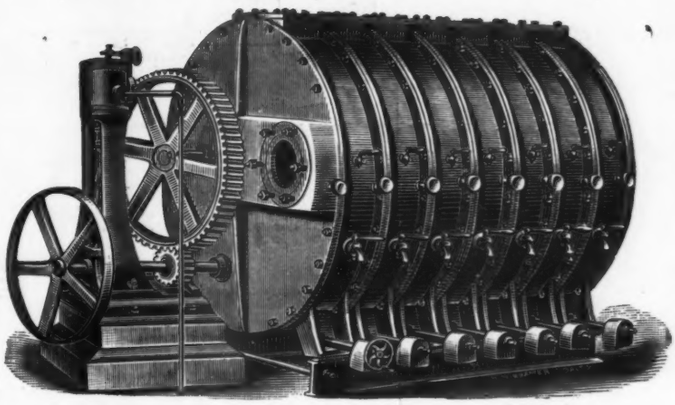

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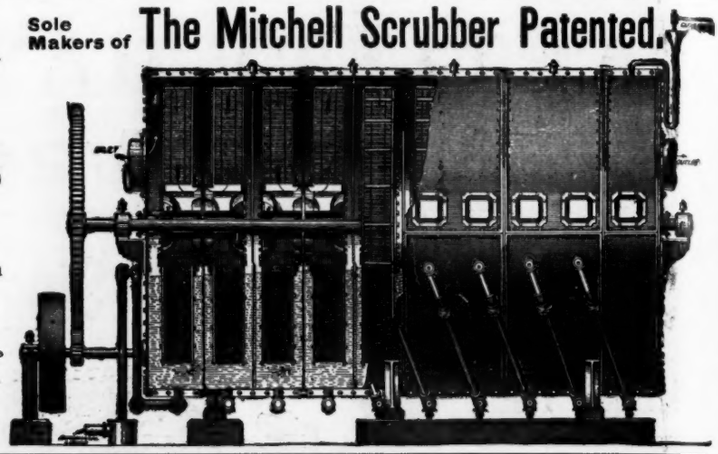

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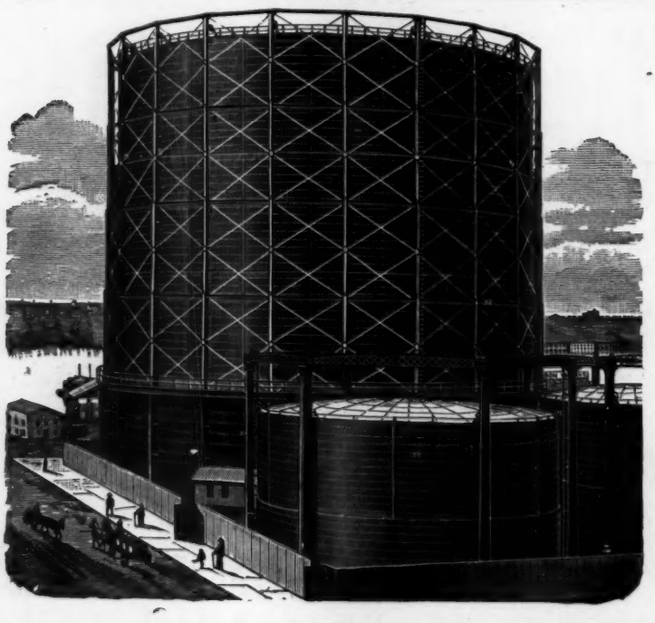

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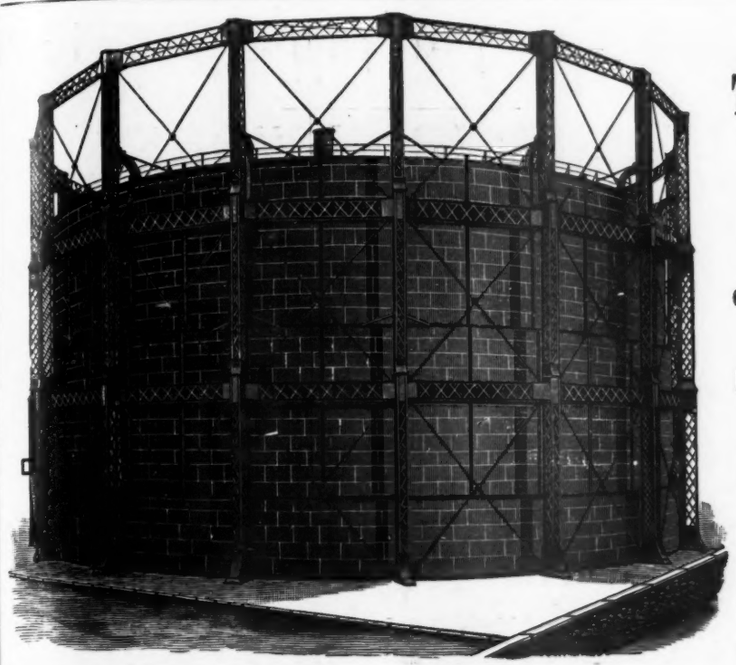

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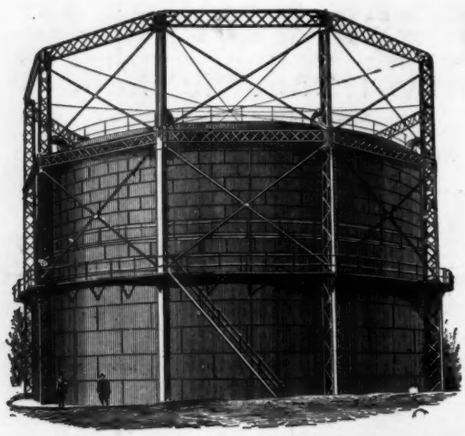

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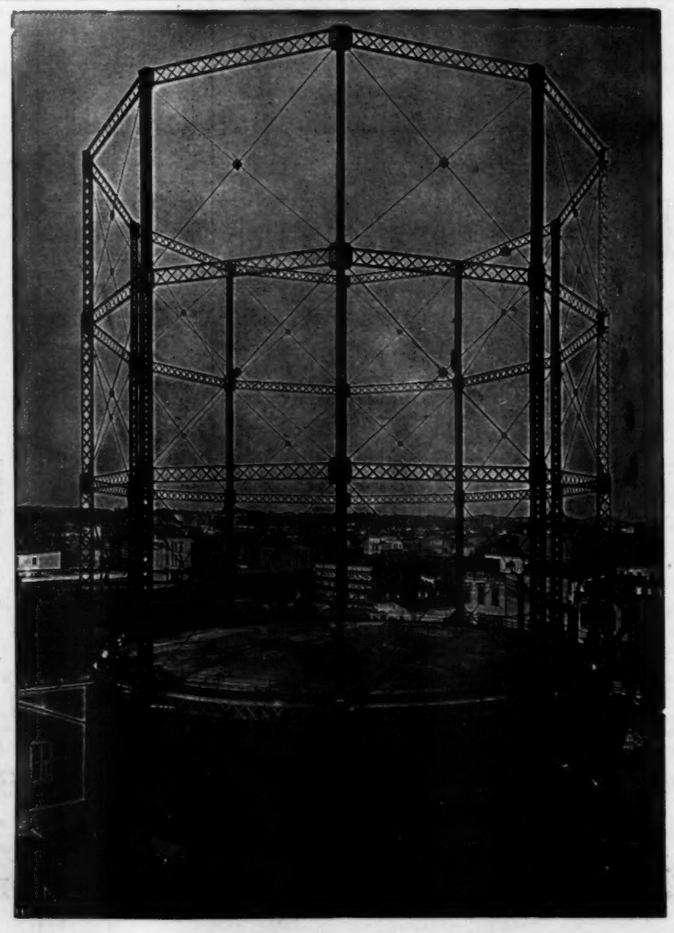

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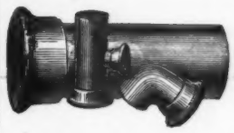

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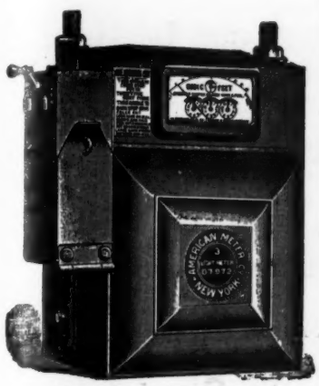

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